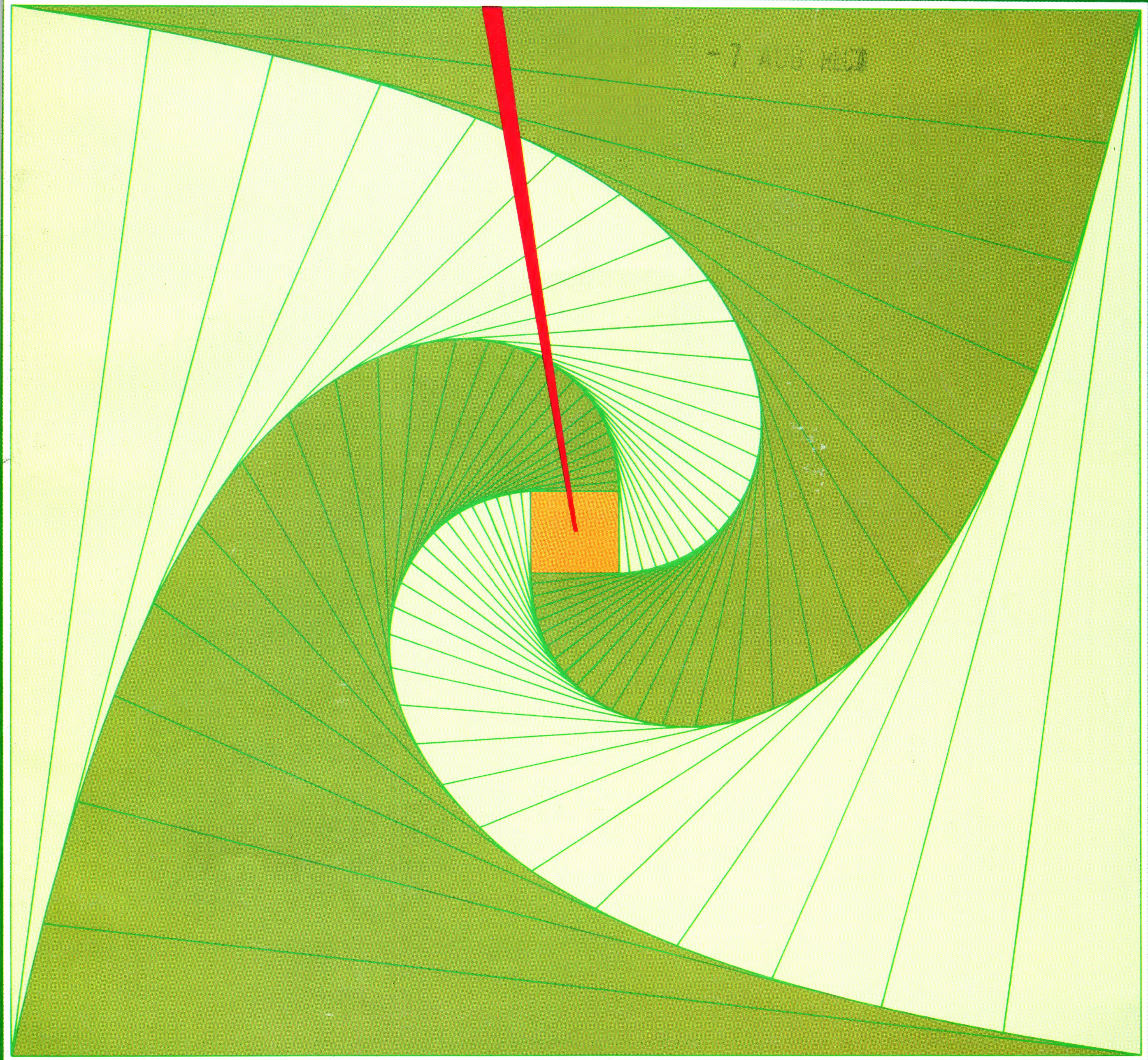
A McGRAW-HILL ELECTRONICS PUBLICATION JULY 30, 1984 $3

ElectronicsWeek

Fuse-Programmable Microcontroller

BUILT-IN LOGIC/58

PC BOARDS GO HIGH TECH/47



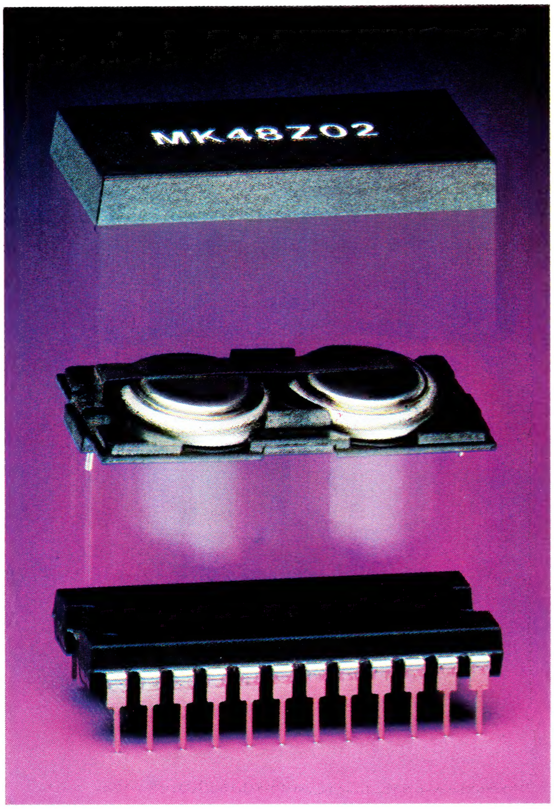
-7 AUG RECD

AT&T and Intel planning personal computer net on twisted pairs/11

Thomson-CSF aims higher in semiconductors/45

High-speed CMOS outpacing bipolar, n-MOS in memory designs/53

UNFORGETTABLE



At last, random access memory that won't let you down. Introducing Mostek's MK48Z02. We call it ZEROPOWER™ RAM. You'll call it unforgettable.

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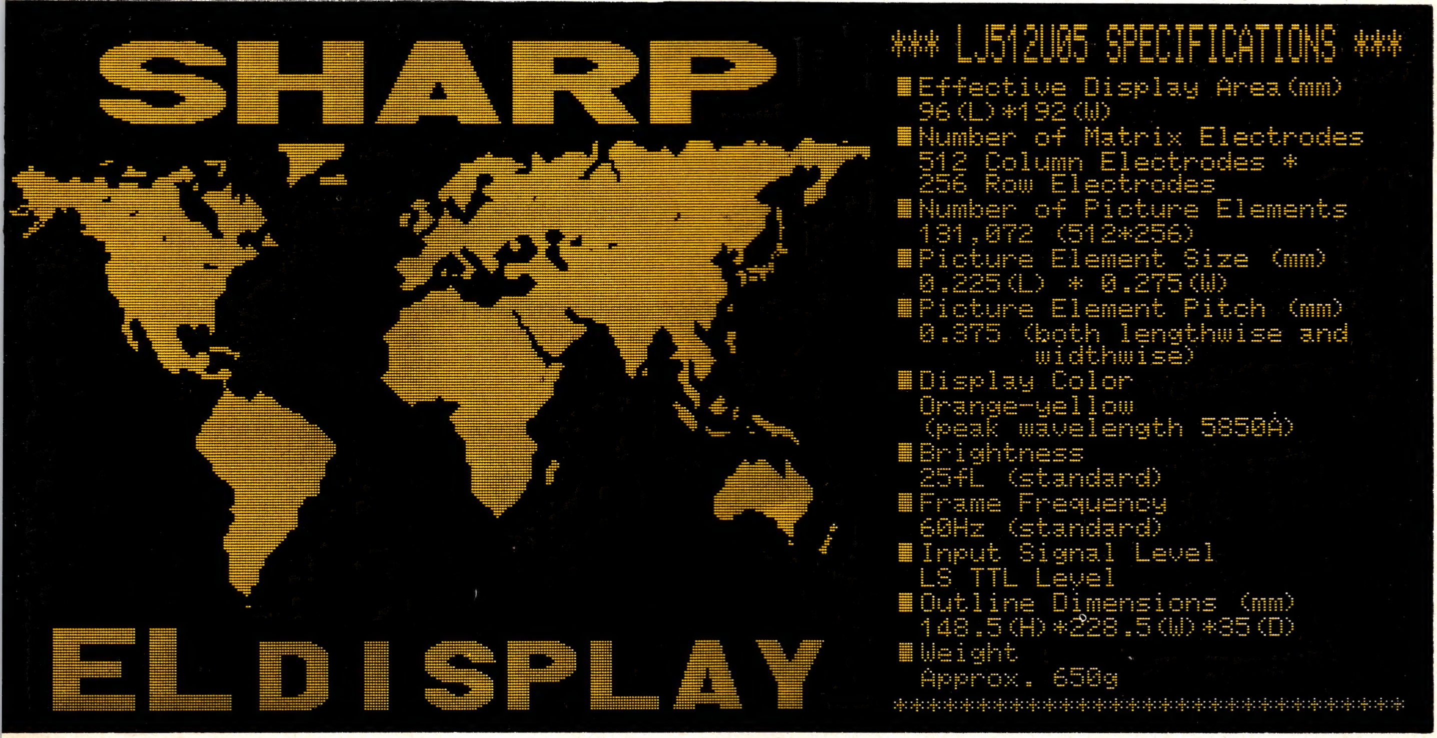

*** LJ512U05 SPECIFICATIONS ***

- Effective Display Area (mm)
  96 (L) * 192 (W)
- Number of Matrix Electrodes
  512 Column Electrodes *
  256 Row Electrodes
- Number of Picture Elements
  131,072 (512*256)
- Picture Element Size (mm)
  0.225 (L) * 0.275 (W)
- Picture Element Pitch (mm)
  0.375 (both lengthwise and widthwise)
- Display Color
  Orange-yellow
  (peak wavelength 5850Å)
- Brightness
  25fL (standard)
- Frame Frequency
  60Hz (standard)
- Input Signal Level
  LS TTL Level
- Outline Dimensions (mm)
  148.5 (H) * 228.5 (W) * 35 (D)
- Weight
  Approx. 650g

****

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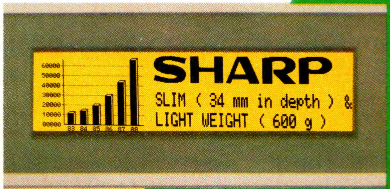
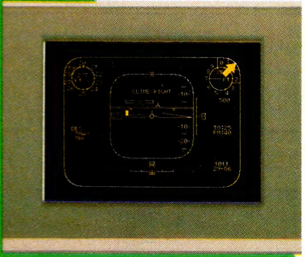
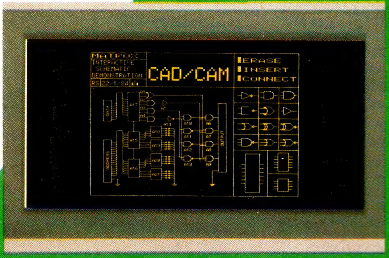


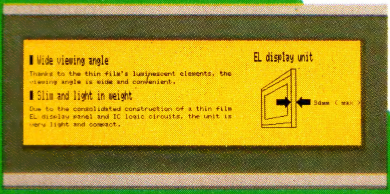
J512U01 • Ideal for written aracters • Effective display area: .8mm×179.2mm • Number of picture ements: 512×128 Dutline Dimensions (mm): 108.5(H) × 8.5(W) × 34(D)



LJ320U01 • Ideal for fine graphics as well as written characters • Effective display area: 90mm×120mm • Number of picture elements: 320×240 • Outline Dimensions (mm): 148.5(H) × 178.5(W) × 34(D)



J512U05 • Ideal for fine graphics as ell as written characters • Effective splay area: 96mm×192mm • Number picture elements: 512×256 Dutline Dimensions (mm): 148.5(H) × 8.5(W) × 34(D)



LJ640U01 • Ideal for written characters • Effective display area: 60mm×192mm • Number of picture elements: 640×200 • Outline Dimensions (mm): 108.5(H) × 228.5(W) × 34(D)

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ElectronicsWeek

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VOLUME 57, NO.16 JULY 30, 1984

ElectronicsWeek

Special Reports

PC boards A new high-tech industry starts to emerge. The printed-circuit-board industry is being shaken by more demanding customers, and it is responding by applying the newest technologies **47**

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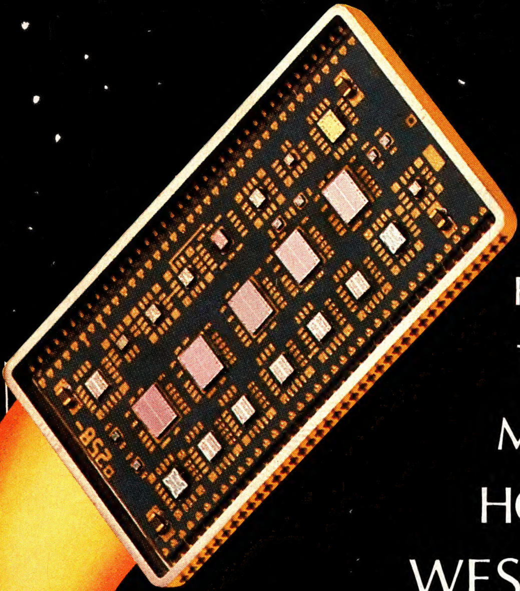
Hybrid Users Have Had It Up To Here With Algorex Performance.



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Next ElectronicsWeek:

Exotic material, exciting applications

Kynar piezo film is a new transducer material converting one form of energy to another. At the same time, it is a piezoelectric and a pyroelectric. As a piezoelectric, it provides classic transformation from mechanical deformation to electrical signals and vice versa. Its pyroelectric properties convert infrared heat radiation into electricity. Research conducted at Penwalt Corp. has uncovered several interesting applications for the heretofore little-known material.

In ElectronicsWeeks ahead:

It's clear, video products are going digital

Although digital technology has not yet lived up to its potential in the television market, the trend among TV manufacturers appears unstoppable. *ElectronicsWeek*'s Industrial & Consumer Editor David Weber is putting the finishing touches on next issue's cover story, which examines new developments in the video-design sector.

How good is high-rel?

When a semiconductor manufacturer performs 100% testing of parts shipped, every unit should be good. According to test engineer Eugene R. Hnatek, of Viking Laboratories, that is a much too common and dangerous assumption. In an article for *ElectronicsWeek*, Hnatek exposes myths about high-rel components and details several ways to avoid poor quality.

Automated structure analysis

Developments in automating structure analysis are removing many problems associated with manual applications. An automated approach lends itself to higher productivity levels and may become the principal method for software design in the late 1980s. Norman L. Kerth of Tektronix will explain the technique and the advantages of the structured approach.

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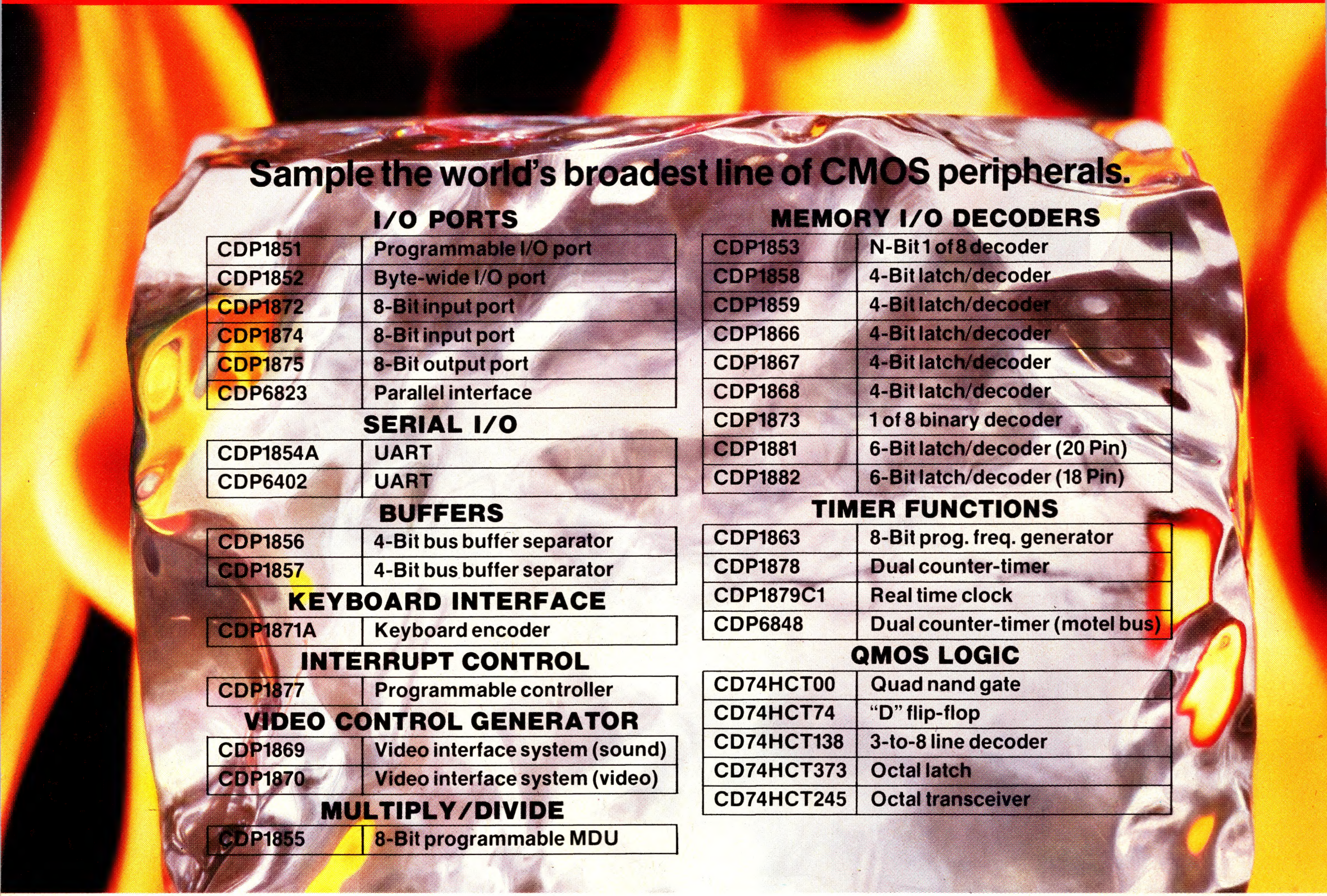

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CDP1874	8-Bit input port
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CDP6823	Parallel interface

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CDP6402	UART

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CDP1856	4-Bit bus buffer separator
CDP1857	4-Bit bus buffer separator

KEYBOARD INTERFACE

CDP1871A	Keyboard encoder

INTERRUPT CONTROL

CDP1877	Programmable controller

VIDEO CONTROL GENERATOR

CDP1869	Video interface system (sound)
CDP1870	Video interface system (video)

MULTIPLY/DIVIDE

CDP1855	8-Bit programmable MDU

MEMORY I/O DECODERS

CDP1853	N-Bit 1 of 8 decoder
CDP1858	4-Bit latch/decoder
CDP1859	4-Bit latch/decoder
CDP1866	4-Bit latch/decoder
CDP1867	4-Bit latch/decoder
CDP1868	4-Bit latch/decoder
CDP1873	1 of 8 binary decoder
CDP1881	6-Bit latch/decoder (20 Pin)
CDP1882	6-Bit latch/decoder (18 Pin)

TIMER FUNCTIONS

CDP1863	8-Bit prog. freq. generator
CDP1878	Dual counter-timer
CDP1879C1	Real time clock
CDP6848	Dual counter-timer (motel bus)

QMOS LOGIC

CD74HCT00	Quad nand gate
CD74HCT74	"D" flip-flop
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Standby power	mW	μW	Yes
Speed	High	Medium/High	
Operating frequency range	Limited	DC to max	Yes
Operating voltage	4.5V to 5.5V	4V to 10V	Yes
Noise immunity	10% of supply voltage	30% of supply voltage	Yes
Temperature range	0° to 70° C	-40° to +85° C Military: -55° to +125° C	Yes
Chip complexity and size	Same	Same	
Gate arrays and Semi-custom availability	No	Yes	Yes

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AT&T BARES BARGAIN NET FOR OFFICES

Twisted-pair Star LAN for microcomputers runs at 1 Mb/s and has Ethernet coding; but the IEEE rebuffs initial bid to establish it as standard ☐ *by Clifford Barney*

Vancouver, B.C., Canada

AT&T Information Systems has a local network in the wings that uses ordinary unshielded twisted-pair telephone wire and promises to cut the cost of connecting an office's personal computers to $150 or so a station. That's about one fifth the cost of an Ethernet connection and about half that of "Cheapernet," an Ethernet version that substitutes TV-quality coaxial cable for more expensive local-net coaxial cable.

First look. AT&T gave the first detailed look at the new system, called Star LAN, at a late-July meeting in Vancouver of IEEE committee 802.3, which handles standards for local-area nets that use carrier-sense multiple-access collision-detection technology. Like Ethernet, Star LAN uses a collision-sensing multiple-access protocol with collision detection; however, it operates at only 1 Mb/s, one tenth the Ethernet data rate.

Its throughput is comparable to that of the Omninet network, marketed by Corvus Systems Inc., of San Jose, Calif. (though unlike Omninet, Star LAN offers collision detection). Omninet is one of dozens of low-cost proprietary nets intended to fill a gap left by the generally more powerful but far more expensive backbone local nets.

The low-cost nets have been constrained by their proprietary interfaces; the backbones have been used mainly to connect high-performance work stations and are considered too expensive for office use. (The rule of thumb is that a local-net connection should not cost more than 15% of the station's cost.)

Star LAN could connect to a high-speed baseband or broadband backbone through a bridge or gateway. In addition, its use of ordinary phone wire makes it easy to integrate with private branch exchanges.

Timothy A. Rock of AT&T's Office Information Systems Laboratory in Holmdel, N.J., was careful to say that Star LAN is not a committed product for the firm. But representatives of other firms involved indicated that they would probably offer a product themselves, whatever the IEEE or AT&T may do.

"Within two or three years, there will be more equipment, in dollar value, connected to this network than to any other kind of local net," said one engineer who had worked on the proposed IEEE specification.

The IEEE group rebuffed the initial effort by a consortium led by AT&T and Intel Corp. to establish

Net set. Robert Galin of Intel (left) talks with Timothy Rock of AT&T Information Systems about the VLSI chip Intel has on the way for AT&T's low-cost local network.

the Star LAN's specs as a 1-Mb industry standard. Intel will provide a very large-scale integrated circuit for coding and access control. Also contributing to the proposed specification were Tandem Computer Corp., Wang Laboratories Inc., and NCR Corp.

Although it refused to give the task force a go-ahead to develop Star LAN's specifications as a full IEEE standard, the 802.3 committee voted to keep the project under evaluation and asked the 15-member task force to report back in October with more financial and technical details.

The study team will meet in September at Wang headquarters, in Lowell, Mass., to develop details on user costs, the need for a fault-tolerant hub, and the legal and practical aspects of AT&T's desire to use already installed phone wire.

"We didn't have time for sufficient discussion to make a decision on putting full resources into writing a standard," explains 802.3 chairman Don Loughery of Hewlett-Packard Co. "AT&T presented a wealth of new material that people had not had time to think about."

Robert Galin, Intel's director of strategic planning for peripheral components, says that the Santa Clara, Calif., firm's new IC, to be available this year, combines the functions of the firm's present two-chip Ethernet set, which includes a Manchester codec and a CSMA/CD controller. AT&T reportedly has samples, although Rock says that the prototype network was built with commercial Intel Ethernet chips and a programmable logic array for collision detection.

Low budget. The proposed standard's chief functional requirement was a station cost (excluding wiring) of less than $50 by 1986. At Vancouver, Wang presented a parts list that allowed $13 for the VLSI controller (presumably, the new Intel chip), $2 for a pair of line drivers and receivers, $8 for connector hardware, and $5 for a protection circuit. Shared among 20 stations, the prorated cost of a hub was $20, so the total was less than $50. Rock said that the prototype cost about $80. Of course, the station's installed price would include labor costs and profit and might run three or four times the cost of bare parts.

The expense of cabling—a stumbling block for the acceptance of local nets in general—spurred the development of Cheapernet and a low-cost Ethernet version offered by the 3Com Corp. of Mountain View, Calif. Ethernet cable, installed in ceiling ducts, can cost $2 to $4 a foot. Cheapernet substitutes 20¢/ft cable TV coaxial cable and does away with an expensive transceiver, though at a sacrifice in area covered and the number of stations that can be served.

In Vancouver, Rock pointed out that the use of unshielded twisted-pair cabling means that in many cases, users can attach personal computers to existing phone cables. These lines contain 25 or more pairs, only 8 or 10 of which are normally used, he said. Moving a personal computer would be even easier than moving a telephone, since the computer can identify itself on line, while the phone wires must be physically reconnected.

Backbone. The idea of a gateway or bridge to a backbone network raised several questions for the 802.3 committee, some of whose members felt that Star LAN should also account for gateway costs. Both Wang and AT&T offered diagrams showing the new network connected to a 10-Mb/s Ethernet backbone or to a different broadband or baseband system.

While acknowledging that there would be some additional cost, Intel's Galin resisted attempts to impose bridge specification requirements on the working group for 1-Mb/s local nets. "That goes beyond the scope of what we want to do," he said.

The Star LAN could be connected to AT&T's 3B network, a 10-Mb/s net also based on the Intel chip set; moreover, the wiring scheme Rock proposed left open the possibility of a link to AT&T's fiber-optic Information Systems Network. A 1.544-Mb/s T-1 telephone line could be bridged to Star LAN and allow users to mix compressed video, voice, and data.

The only limit to the number of stations that can use the network is the 1-Mb/s bandwidth. Wang's David P. White presented a paper at Vancouver suggesting that more than 150 stations could coexist on the net without saturating it.

Wang makes its own high-speed broadband network, Wangnet, intended for companywide backbone

Logic hierarchy simplifies data transfer

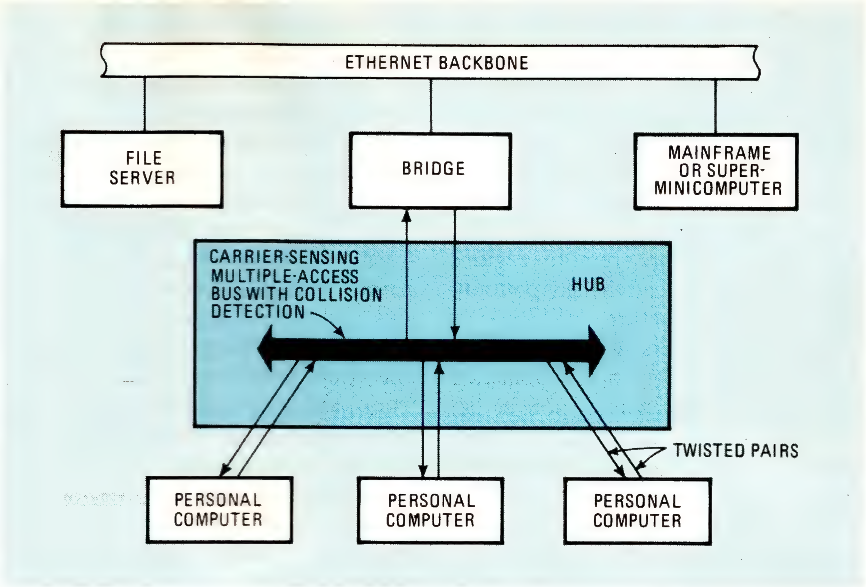
Star LAN is built from standard telephone company wiring and connectors. Although physically a star topology, it is actually a bus, albeit a short one—1 meter long—to which personal computers are attached by 600-to-800-ft drop lines. The bus itself is in a wiring-closet "hub" where the lines terminate at RS-422 line drivers and receivers, which take the place of an Ethernet transceiver. The network will also operate on the cabling scheme presented last month by IBM Corp., and it can be connected to an Ethernet or Cheapernet backbone.

Data collision occurs at the hub, where the four-wire connections to the individual work stations are shorted to a two-wire bus. The hub is intended to support users in a geographically compact cluster, but hubs themselves may be connected in a two-tiered scheme by maintaining the four-wire connection to a logically higher node.

The short bus effectively eliminates signal attenuation, and therefore collision detection can be performed with logic rather than with expensive transceivers that look for voltage shifts in the cable. The Star LAN chip does the job by looking for a phase shift in the Manchester coding by which Ethernet recognizes signals. Manchester coding splits each bit into a signal and its complement, so that there is always a zero crossing at the middle of the time slot for each bit sent. A collision will cause this crossing point to move outside its time window.

The limitation on such a system is jitter in the signal. At the Vancouver 803.2 meeting, AT&T presented data showing that its new system would tolerate 50 ns of timing jitter and that the actual jitter—as shown by oscilloscope traces—was 35 ns.

—**Clifford Barney**



Traffic control. Collision detection in Star LAN is made in the hub, where twisted-pair drop lines from microcomputers in the net are shorted to a two-wire bus about 1 meter long.

local nets. Star LAN is meant for clusters of personal computers. NCR makes a 1-Mb/s CSMA/CD bus called Mirlan, which also uses an Intel chip.

The full 802.3 committee also showed some resistance to implementing yet another CSMA/CD standard. Chairman Loughry has said that the second revision of the Ethernet specification, published in November 1982, is substantially compatible with the 802.3 standard approved by the IEEE a year ago and sent along to the International Organization for Standardization (ISO) for consideration as an international standard.

However, the committee had authorized the drafting of the 1-Mb/s spec last February after Intel's Galin put together the task force, arguing that a low-cost local net implementation was imperative to satisfy user need. Following the Vancouver meeting, there were indications that some companies were interested in building the AT&T network. Toshiba reportedly has begun negotiating with another Japanese company for a version of the Intel chip. ☐

SATELLITE COMMUNICATIONS

France's Telecom 1 adds multiuse links to repertoire of industrial communications in Western Europe

Paris—If this week's mission succeeds, the European Space Agency's Ariane launcher should pass a watershed in business communications for France and for much of the rest of Europe. One part of the rocket's payload will make the difference: Telecom 1, the French national telecommunications satellite.

It will give industrial clients access to communications channels ranging from ordinary data links of several kilobits per second up to Mb/s connections that create the possibility of widespread videoconferencing. For these services, the satellite will cover a geographical area extending as far as Denmark and the southern tips of Norway and Sweden in the north, Austria in the east, Rome in the south, and England in the west.

Telecom 1 was conceived in 1979 by the French Direction Générale des Télécommunications, which hoped to achieve three goals. Besides offering new services for business customers, the satellite will serve as a transit network for telephone connections between France and its territories in the Caribbean Sea and the Indian Ocean. It will also give the French armed forces an operational satellite telecommunications network that is dedicated mainly to maritime applications.

The project's principal contractor and integrator is Matra SA. Thomson-CSF is responsible for the satellite's payload.

Telecom 1's real originality lies in its flexibility. The satellite's total capacity of 125 Mb/s, divided equally among five on-board transponder-based relays, will be used to offer leased-line data-transmission services at 2.4, 4.8, and 9.6 kb/s, telephone connections at 32 kb/s, switched and leased data lines at 64 kb/s, and leased data or videoconferencing service at 2 Mb/s.

All these services are based on a time-division multiple-access system whose capacity is assigned as a function of load. The system's global frame will consist of five different subframes, one for each of the satellite's transponders, using five different frequencies. Each ordinary station terminal will transmit on a single frequency but will be capable of receiving all five. The system will be managed by a control center in Mulhouse, near Bale, Switzerland, which incorporates a very high-reliability reference station.

Unlike most TDMA systems, where control is completely centralized, some of the Telecom 1 network's command apparatus is distributed throughout the receiving stations—enough to make allocation of capacity, up to the system's overall limit, almost instantaneous. With this type of arrangement, subscribers have access to the satellite only when they need it; the capacity used and the rate paid will depend on the service required. According to Jacques

Cauchy, Telecom 1's commercial and international affairs director, such flexibility would be impossible to achieve using physical transmission media like the telephone network.

Telecom 1's architecture is well suited to a large, highly centralized nation like France. To begin with, the country's more remote regions have virtually no advanced communications infrastructure.

Since most users would transmit data for only a few hours a day, a physical network would not be an efficient solution. It would be very hard to match network configurations to user needs, which tend to change with distressing speed.

Implementation of Telecom 1 is quick and efficient using parabolic antennas 3.5 meters in diameter installed on the users' premises. Most French firms whose activity is dispersed throughout France and neighboring countries will be capitalizing on these advantages.

A users' organization to exchange information on applications has been formed by automobile manufacturers Régie Renault and PSA Peugeot-Citroën, with their extensive dealer and service networks; banks Crédit Lyonnais and Crédit Agricole, which depend largely on nationwide branch operations; the nationalized petroleum-products company ELF-Aquitaine; and Agence France Presse, the national news agency.

Most users admit that they will be feeling their way along when the new European satellite becomes operational in October. They indicate they will develop new services as they go along. –**Robert T. Gallagher**

FIBER OPTICS

Lightwave multiplexer transmits four channels over a single fiber

Kakakura, Japan—The economical office and factory automation systems of the future appear to be closer at hand with Mitsubishi Electric Corp.'s development of a simultaneous two-way transmission technique for analog TV signals and medium-speed digital signals over a single optical fiber. Four separate wavelengths can be multiplexed, so a single fiber to the telephone company office can replace the more expensive multiple-fiber cables that are now in use.

Operation is reliable for distances up to 7 km, which in most cases easily encompasses the distance from subscribers' premises to the telephone offices nearest them. A typical application of a practical system might be a 24-trunk private branch exchange and three high-speed digital peripherals.

Engineers at Mitsubishi's Information Systems and Electronics Development Laboratory here admit that they were not the first to demonstrate multiplexed optical transmission systems, but they say that their prototype system is probably the most completely developed to be unveiled. The analog TV signal provides teleconferencing, while the digital signals can be used for pulse-code-modulation telephone trunks, high-speed peripherals, and other data-transmission applications.

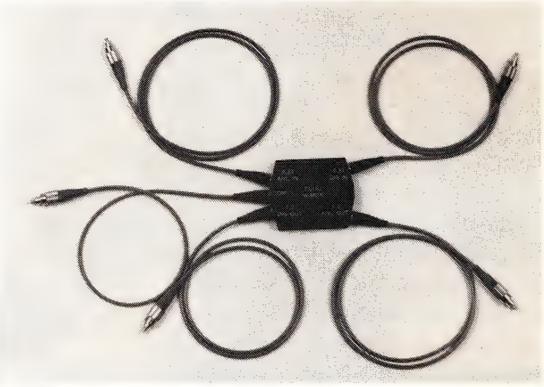
One of the practical considerations this system can address is the independent operation of the facilities. The digital circuits include supervisory circuits, which telephone companies usually transmit separately on metallic cable. The TV circuits include both supervisory circuits and an auxiliary phone channel in addition to standard video and TV sound.

The four wavelengths Mitsubishi used are 0.81 μm, generated by a light-emitting diode; and 0.89, 1.2, and 1.3 μm, generated by laser diodes. The two shorter wavelengths are for transmission to the telephone office; the two longer ones transmit to the subscriber. All four wavelengths are propagated with low loss by relatively low-priced optical fiber with a core diameter of 50 μm and a clad diameter of 125 μm.

Many arms. The key component in realizing this system is an optical multiplexer positioned at each end of the single fiber. The multiplexer combines the two locally generated optical signals to be launched on the fiber and divides the two optical signals arriving from the far end. With four optical-fiber ports for individual wavelengths and one for the multiplexed fiber, the optical multiplexer has a spider-like appearance.

The multiplexer incorporates wavelength filters fabricated with multilayer thin-film technology and lenses consisting of short lengths of large-diameter graded-index fiber. The experimental multiplexers that Mitsubishi used for the four-way unit build on the technology already employed in commercial units to handle two wavelengths. To implement a practical system, Mitsubishi must now develop low-cost versions of the multiplexers.

For several reasons, it is difficult to modulate the amplitude of the lasers for the TV signals without distortion. Reflections from joints at cable connectors and interference among coherent modes of the lasers' output both affect laser output characteristics.



Heavy duty. Optical multiplexer has four optical-fiber ports for individual wavelengths and one for multiplexed fiber. It can handle duplex TV and digital signals simultaneously.

Reflections are eliminated when the fiber ends are ground at an angle that is 8° from the perpendicular. Coherency is reduced by superimposing an 850-MHz signal on the laser-driving current to broaden its spectrum. Furthermore, optoelectric negative feedback around the laser improves linearity and suppresses noise output. The amplitude-modulated TV signal has a bandwidth of 30 Hz to 4.2 MHz. **–Charles L. Cohen**

EXPERT SYSTEMS

AI package runs on desktop unit

Austin, Texas—Believing it has moved artificial-intelligence technology closer to everyday life, Texas Instruments Inc. plans to unveil next week an AI software-development package aimed at placing knowledge-base expert systems on desktop personal computers. Called the Personal Consultant, the development tool will make its debut here at the American Association of Artificial Intelligence Conference (see p. 30).

The package consists of Personal Consultant development software, two samples of knowledge bases, IQ-Lisp programming language (from Integral Quality Inc.), and documentation. When available next quarter, it will have a $3,000 price tag; TI's System Group in Austin will sell it through direct-sales channels.

Personal Consultant is the result of six years of research. Using a TI Professional Computer, it can create an expert system of about 400 "rules of thumb," representing the knowledge of authorities in a particular field. The software takes programmers through expert system development using a rule-specification language, an interactive editor, a knowledge-base lister, and debugging aids. Similar packages are Expert Ease [*Electronics,* Feb. 9, 1984, p. 50] and M.1 [June 14, 1984, p. 166].

The software consists of a development engine and an inference subsystem. The development engine is used to create knowledge data bases. Once the knowledge base is completed, the development portion can be removed from the software, which can then reside on as little as one floppy disk. The inference subsystem applies the knowledge-base rules in order to make conclusions or recommendations. **–J. Robert Lineback**

News Briefs

Negotiated end to IBM-EC case awaited

IBM Corp.'s overseas competition is holding its breath as the European Commission is expected to announce a negotiated settlement in its antitrust suit against the U.S. firm—at least that was how most industry observers interpreted the postponement of a press conference scheduled at commission headquarters in Brussels early last week. After a weekend of intense talks, officials there said they were "mildly optimistic" about the outlook for a settlement of the 12-year-old case, though no one ruled out the possibility of a complete breakdown. The commission has accused IBM of withholding information about the interfaces to its mainframe computers until it begins shipping the machines to customers. This, says the commission, gives the U.S. giant an unfair advantage over competitors who want to compete in the market to supply peripheral equipment for IBM computers.

Hitachi to customize wafers in U.S.

Hitachi Ltd. plans to expand its U.S. gate-array and mask read-only memory efforts by performing aluminum metallization processes and assembly at a new $41 million plant in Irving, Texas. Turnaround time will be shorter and available capacity greater than when design data is transmitted to a factory outside Tokyo. The Texas plant will go on stream in April 1986. After that, Hitachi will also assemble 64-K and 256-K dynamic random-access memories and 64-K CMOS static RAMs from wafers imported from Japan because it expects demand to exceed the capacity of its present U.S. facility, also in Irving.

STC mounts bid to take over ICL

Standard Telephones and Cables plc late last week launched a surprise $467 million bid for Britain's flagship computer firm, International Computers Ltd. For openers, the British telecommunications equipment maker picked up 10% of ICL's shares and called for early talks with its management. A long-time ITT subsidiary, STC is now UK-owned and so will not encounter the resistance a U.S. firm would if it tried such a takeover. But the move could trigger defensive counterbids from other UK manufacturers. Recently Thorn EMI plc was outmaneuvered in its bid for British Aerospace and bought Inmos plc instead.

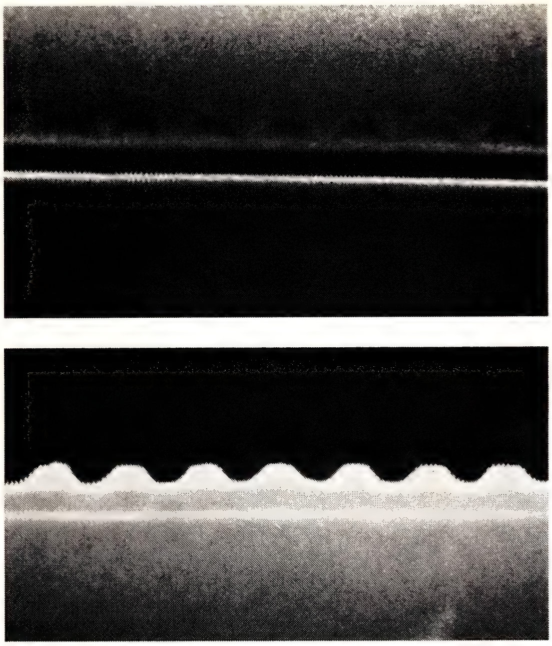
OPTOELECTRONICS

French fabricate monomode laser by low-pressure metalorganic CVD

Paris—A team of French engineers has made a breakthrough in laser diodes that could significantly advance the fabrication of wideband single-mode optical-fiber networks. It takes the form of a single-frequency diode operating in the 1.5- to 1.6-μm-wavelength range, where signal attenuation for optical communications is at its lowest.

The breakthrough springs from a cooperative research project by the Thomson-CSF Laboratoire Central de Recherche (LCR) and the Centre National d'Etudes des Télécommunications III-V materials research group, which are located in the Paris suburbs of Corbeville and Bagneux, respectively.

The laser, which operates at 1.57 μm with very low threshold current, is world-class in its own right, but it is more remarkable for the way it is made, than for performance. Although a handful of single-frequency lasers in the 1.5-to-1.6-μm band with low threshold current have been realized of late—mostly in Japan—they



Key. A corrugated grating atop the guiding layer (bottom) is the key to the single-frequency operation of Thomson-CSF's 1.55-μm laser diode.

are all based on liquid-phase-epitaxy fabrication methods. The French laser is the first of the type made of materials grown exclusively by low-pressure metalorganic chemical vapor deposition, which dramatically improves industrialization prospects.

Bodouin de Cremoux, manager of the Optoelectronics Laboratory at Thomson's LCR, says that two factors reduce liquid-phase epitaxy's attractiveness for such lasers. First, surface deformations caused during regrowth can have serious repercussions on fabrication yields and aging. Second, liquid-phase epitaxy is laboriously slow and capable of treating only small surfaces.

Hoping to explore the possibilities of future large-scale production of optoelectronic components, Thomson began work in metalorganic chemical vapor deposition about three years ago [*Electronics,* Aug. 11, 1982, p. 90]. What then piqued the company's interest was the ability of the process to treat a surface of some 10 cm^2, allowing it to carry out two or three operations a day. In contrast, using operations that take some two days each to complete, liquid-phase epitaxy can deal with only about 1 cm^2.

The laser's fabrication begins with a tin-doped indium phosphate substrate on which a 1-μm indium phosphate confinement layer, a 0.2-μm undoped gallium indium arsenic phosphate active layer, and a 0.2-μm GaInAsP guiding layer have been successively grown using low-pressure metalorganic chemical vapor deposition.

A corrugation grating with a period of 4,700 Å and a depth of 1,000 to 1,500 Å is then etched atop the guiding layer with holographic lithography. This grating acts as a filter, causing the laser to operate at a single wavelength. A 2-μm confinement layer of zinc-doped InP and a 0.5-μm cap layer of zinc-doped GaInAsP complete fabrication.

Thomson and CNET have manipulated the geometry of the new laser's active layer to reduce current density. The result is a threshold current of only 60 mA at 20°C, which means a maximum operating temperature of at least 80°C—easy enough for commercial and industrial applications. –**Robert T. Gallagher**

TELECOMMUNICATIONS

New legislation in Japan to liberalize telecom market will create unknowns

Tokyo—Three bills now wending their way through the Diet, Japan's parliament, would not only liberalize that country's telecommunications business but also create many temporary uncertainties, particularly for would-be foreign suppliers. The bills are expected to pass by the session's end, on August 8.

Under the pending legislation, Nippon Telegraph & Telephone Public Corp. will lose both its 100-year-old monopoly as Japan's common carrier and its de facto control over imports of foreign telecommunications equipment. Kokusai Denshin Denwa Co. Ltd., a public company in which NTT holds a substantial interest, would surrender its exclusive right to handle Japan's international telecommunications traffic.

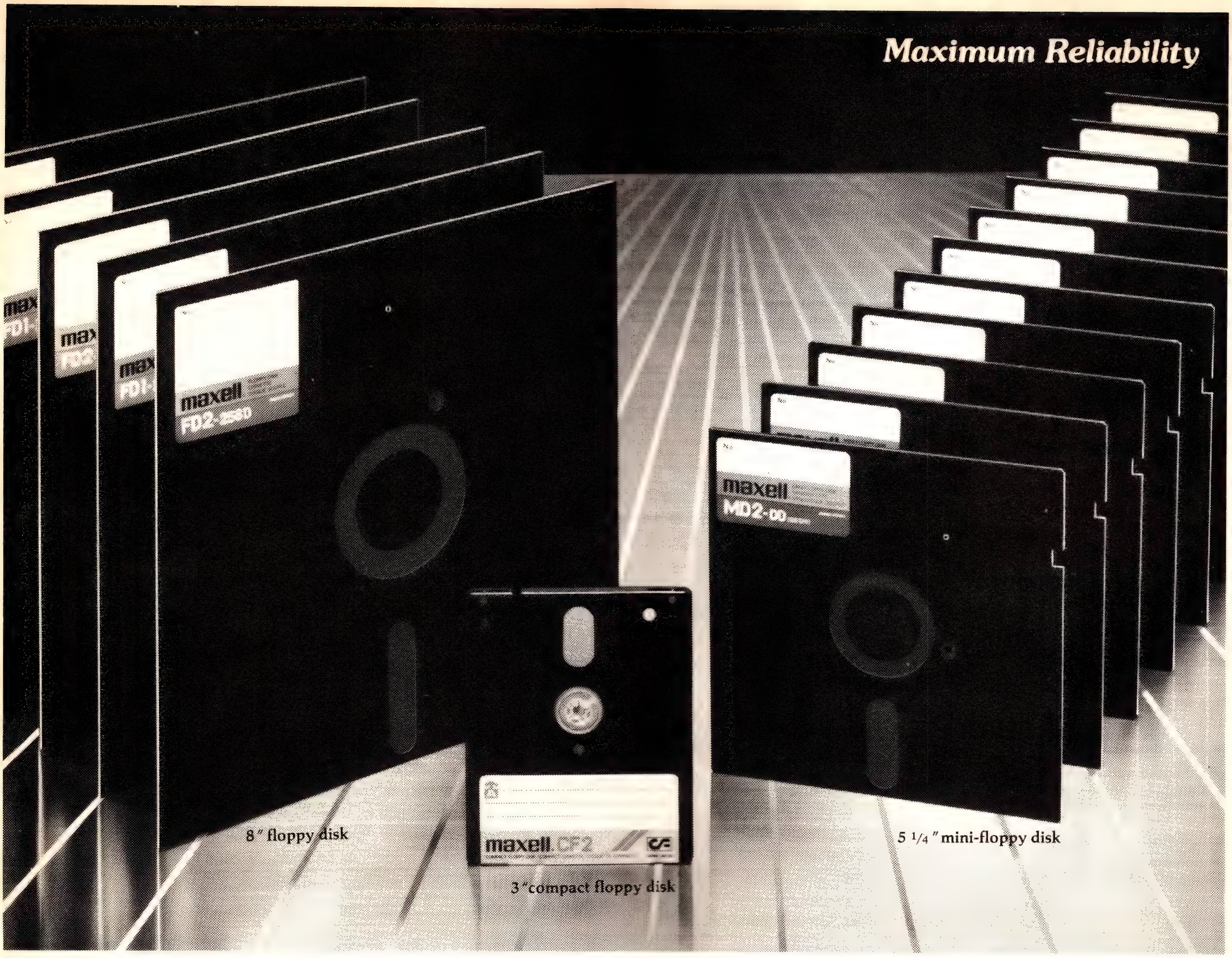
After April 1 of next year, the bills would permit competition in these areas as well as in the important new field of value-added network services, which has been under tight governmental control.

The bills would would let any company with proper financial and technological credentials get started in the common-carrier business if the new entry would not lead to an excessive supply of circuit facilities. These companies must be Japanese, but they can have up to one-third foreign ownership. They will need a permit from the Ministry of Posts and Telecommunications.

The problems posed by the new legislation stem from the postal ministry's continuing power to regulate the industry and from the vagueness with which the bills, like most Japanese legislation, were framed. Even in the competitive market, the postal ministry will have the power to approve tariffs, set equipment standards, and decide how and by whom equipment will be tested.

Since the wording of the bills is so general, U.S. officials want the ministerial ordinances that determine how the legislation will actually be applied to reflect their own views. Such ordinances are usually written by ministries themselves, without outside consultation.

Among the many questions still to be answered are the exact meaning of the notification and registration



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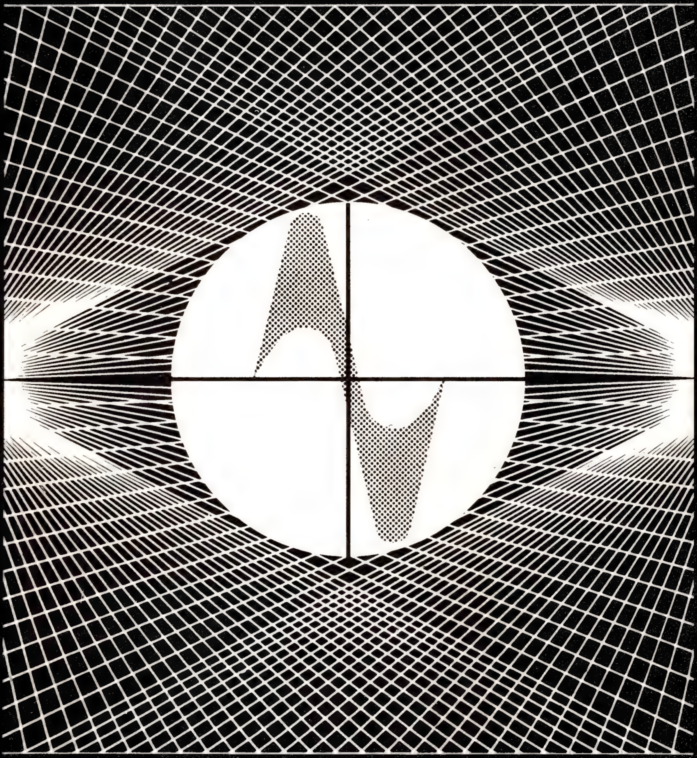

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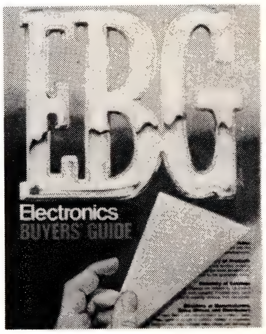

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Uncertainty. NTT's plan to buy more U.S. telecommunications gear has been pushed by NTT president Hisahi Shinto but nonetheless may be in jeopardy.

that will be required to get into the value-added network business and the exact requirements companies will have to meet to win financial and technological approval.

U.S. officials are also fretting about the technical standards the postal ministry plans to apply, whether there will be adequate and convenient testing facilities for U.S. equipment, and whether any U.S. engineers will be licensed to test or install the gear.

In jeopardy? Some also worry that the three-year agreement under which NTT has promised to increase purchases of U.S.-made telecommunications equipment [*Electronics,* Dec. 1, 1983, p. 62] may have to be scrapped or rewritten when the company ceases to be the country's sole buyer. Dr. Hisashi Shinto, NTT's 74-year-old president, has been a driving force in opening up the NTT market, but his term ends in December and it is not yet clear whether the government will reappoint him.

The rules for entering the VAN sweepstakes divide the field between two categories: General Class Two businesses, consisting of small networks (those used locally within one company or common-interest group), and Special Class Two businesses, those large, commercial, and probably nationwide networks. Operators of small nets would have to notify the ministry of their plans; companies intending to provide large networks would have to register with the ministry. Although earlier versions of the law restricted foreign ownership of a participating firm to less than 50%, there is no longer any bar to foreign entrants.

The same provisions cover competition for the international business, now monopolized by Kokusai Denshin Denwa. International value-added networks would also be divided between two categories.

Because of the postal ministry's struggle with MITI for control of VANs, the bills have been in gestation for more than a year. They have already spawned one declared common-carrier competitor, and three others are waiting in the wings.

A group called Daini Denden Inc., led by ceramic-package maker Kyocera Corp. [see p. 43], says that it will build digital telecommunications links along Japan's densely populated Tokyo-Nagoya-Osaka corridor. Two other groups with right of way along this route—Japan National Railways and the Construction Ministry, with its affiliated Japan Highway Public Corp.—are interested, too. Another contender, Keidanren, the Japan Federation of Economic Organizations, has talked about using a satellite to serve the same area.

Big enough? Senior government officials worry that these groups will not have enough clout to challenge NTT, a company with 1983 revenues of $18 billion, and they are urging some participants to merge. It therefore seems likely that only one or two companies will end up competing for the common-carrier business.

So far, no foreign companies have rushed to take advantage of the new legislation's ownership provision. Daini Denden, for one, would welcome a foreign partner.

The VAN business—still in its infancy in Japan, since MPT has allowed only 40 groups to set up local networks—has yet to attract formal entrants. But AT&T Co., which has the AIS Net 1000 system, and IBM Corp., with its Information Network system, are interested. Both would probably operate with Japanese partners.

The competition for Kokusai Denshin Denwa's international business is not likely to materialize for some time, according to company sources. The most probable rivals are U. S. operators of value-added networks such as GTE Telenet, IBM, and AT&T.

–Peter Hann

SOFTWARE

Modules work alone, together

London—A new microcomputer software offering is bidding for a place in the sweepstakes for integrated business programs. The new offering, Xchange, is a modular set of four business programs with a double appeal. Though the programs can be linked into an integrated software

New release. Psion Ltd.'s new integrated business software, Xchange, addresses a wider market than its competition, believes David Potter, chairman and managing director of the British firm.

system like those from the firm's competitors, users can also purchase each separately.

Available from four-year-old British firm Psion Ltd., Xchange runs under MS-DOS and will compete with Lotus Development Corp.'s newly introduced Symphony, Ashton-Tate's Framework, and a new number from Ovation Inc. The last two are due out shortly.

All are targeted at an estimated $2 billion market for microcomputer software, which includes both integrated and individual business applications. Xchange can be purchased as separate programs or as a whole for $653, which represents a 35% discount over the individual prices.

Switch around. Xchange integrates four applications programs: word processing, data-base management, financial planning or spreadsheet, and business graphics. A user can quickly switch from one task to another and transport information between programs with a few keystrokes.

The product's modular approach is possible because it uses a task- and file-based scheme rather than a spreadsheet-based approach. This way, different data files can be established and then linked together. With spreadsheet-based systems, data manipulation is limited by the memory size of the spreadsheet model.

There is some debate over which method is actually more beneficial for users. However, as Ann L. Morley, a software industry analyst with International Data Corp., Framingham, Mass., points out, not many copies of new-generation integrated software using either approach have been shipped to customers at this time, so that there is very little reaction from users as yet.

"Each program is at least as powerful as any existing product in the marketplace and, unlike other integrated suites, [each] can compete independently with current industry leaders," Potter claims. This also means that Xchange addresses a wider market than any of its competitors, according to Potter.

Xchange requires a minimum of 256-K of random-access memory and a 320-K floppy-disk capacity. The software is organized so that the user can have "access to greater levels of sophistication as his confidence and experience grows," says Potter.

Adaptable. The product will be available at the end of next month for IBM Corp.'s Personal Computer, and the IBM PC XT, as well as for the popular British machines, Apricot and Apricot XI, made by Applied Computer Techniques Ltd. in Birmingham, and the Victor 9000, made by Sirius Computers Inc.

By fall, when Psion opens a U.S. subsidiary, planned for a Connecticut suburb of New York, Xchange will have been adapted for Apple Computer Inc.'s Macintosh, Digital Equipment Corp.'s Rainbow, and several other leading machines. In addition, according to Potter, Psion has signed agreements with several business microcomputer manufacturers. **–Kevin Smith**

PICKUP TUBES

Color camera tubes are flourishing as they shrink in size and weight

Tokyo—Japanese makers of leading-edge solid state imaging components such as charge-coupled devices and MOS sensors continue to develop pickup tubes for color video cameras. The older technology is hanging on, despite its relative disadvantages in size, weight, and power consumption, because the tubes are easier to manufacture and cheaper; at the same time, they offer better performance, notably in sensitivity, resolution, gradation, and noise level.

Diminutive. The latest to come to market with a small pickup tube is Sony Corp., one of the leaders in CCD imagers. Sony has squeezed a ½-in. tube into a smaller and lighter package with a design that uses electrostatic focusing and deflection. This eliminates the size and weight of the magnetic yoke that is conventionally used for magnetic deflection.

Hitachi Ltd., which manufactures MOS color sensors, has just followed suit with a new ½-in. tube that is more compact than its predecessor. Moreover, Hitachi has added a 1/3-in. tube; the smaller size, however, represents a tradeoff in that its resolution is only 240 TV lines, compared with the 300-line resolution that ½-in. tubes have.

Even so, Sony's tube and its shield fit in a package measuring only 18 mm in diameter by 62 mm in length. The unit has a volume only 75% that of Hitachi's 1/3-in. tube and a mere 60% that of Hitachi's new ½-in. tube and yoke. The Sony tube and shield weigh in at 16 g, compared with 30 g for the Hitachi 1/3-in. tube and yoke and 40 g for Hitachi's ½-in. unit. **–Charles L. Cohen**

Gate array makers must shrink dies to expand markets in the face of a strong challenge from standard cells

By most accounts, gate array components along with their fast design-to-production cycles are likely to remain champions of semicustom-chip markets in the 1980s. In two years, worldwide demand is expected to be just beneath the $1 billion mark, with annual growth rates exceeding 30%. Well over 60 firms continue to vie for a secure position in the still unsettled business.

But when it comes to the next decade, divination is less certain around the industry. By then, many predict, standard cell design technology will have matured enough to combine improved turnaround cycles with the greater flexibility and die-size efficiencies it offers today. Meanwhile, others counter that gate array sales are expected to remain strong as chip buyers increasingly emphasize even shorter delivery cycles.

Sizing up. Most agree, however, that the size and growth of future array markets hinge partly on the actual size of the silicon chips themselves. With smaller real estate, arrays can become more efficient and be better suited to handle the standard cell onslaught.

Array houses—many of which are already actively pursuing standard-cell business—are counting on a mixed bag of new processing technologies, routing software, and layout architectures to boost silicon usage. Within two years, several suppliers—mostly in Japan—are planning to provide master slices with as many as 20,000 uncommitted gates.

"There is no question that reductions in dies of gate arrays will certainly help keep them percolating along," notes Richard Jacobs, manager for U.S. field applications engineering of semicustom chips at Motorola Inc. in Phoenix. "But we feel there will be a strong demand for both technologies—gate arrays and standard cells. The only question is which will grow faster and whether one will inhibit the growth of the other." Motorola, which offers bipolar and high-speed complementary-MOS macrocell arrays, is planning a move into the commercial standard cell markets.

Today, a typical 2,000-gate logic array is about 55,000 mil^2 using a single-metal 3-μm process, says William J. McClean, research analyst at Integrated Circuit Engineering Corp. in Scottsdale, Ariz. Assuming 80% to 85% utilization of the 2,000 gates, identical semicustom design can be implemented on a 28,900-mil^2 standard cell, estimates McClean.

Growth seen. In an upcoming ICE midyear study, he predicts that logic array demand will hit $1.1 billion in 1987 (see table). "I think standard cell technology will start to show signs of taking over after 1987, and it will be a big contributor in slowing the growth of gate arrays," he adds.

In July, Dataquest Inc. of San Jose, Calif., revised upwards its semicustom array projects to $1.6 billion in 1987. For 1984, the market research firm places worldwide demand at between $740 million to $780 million, with a compounded annual growth rate of 34% over the next six years.

Standard cells, which are expected to hit $100 million this year, are surging by a growth rate of 72%, says Andy Prophet, senior analyst with Dataquest's Semiconductor Industries Service. "The reason why people believe standard cells will grow faster is that you can do so much more with them," he notes. "But there has been a fundamental problem: the computer-aided design tools have not been there. That has caused interested suppliers to jump onto the gate array bandwagon in the interim."

Some warn the issue of die sizes could even play a factor in the industry's ability to meet demand. Year-old Integrated Logic Systems Inc. of Colorado Springs, Colo., believes the industry is stuck in a dilemma between big chips and big demand.

Trimming size. "These extremely large chips are going to require class 100 or better clean rooms, which basically boils down to the fact that older fabrication lines cannot be used," says David L. Taylor, president and founder of Integrated Logic

WORLDWIDE MARKET FOR NONSTANDARD ICs
(MILLIONS OF DOLLARS)

Market segment	Year										Compound annual growth rate (%)
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	
Gate arrays	120	145	265	455	635	790	950	1,100	1,240	1,400	31
Linear arrays*	10	25	35	55	80	110	150	200	260	325	47
Total semicustom	130	170	300	510	715	900	1,100	1,300	1,500	1,725	33
Standard-cell ICs	12	25	40	90	180	400	750	1,200	1,800	2,500	81
Full custom ICs	500	550	650	775	925	1,125	1,350	1,625	2,000	2,500	20
Total custom	512	575	690	865	1,105	1,525	2,100	2,825	3,800	5,000	29
Programmable logic	33	80	175	260	420	530	635	750	885	1,020	46
Total nonstandard IC market	675	825	1,165	1,635	2,240	2,955	3,835	4,875	6,185	7,745	31

*Includes linear-digital ICs

SOURCE: INTEGRATED CIRCUIT ENGINEERING CORP

Start-up warns of logic-chip shortage

Aware that his warnings might engender considerable eyebrow-raising, the president and founder of a year-old start-up in the gate-array business believes the semicustom chip industry will be hard pressed to meet a demand projected to exceed $1 billion in 1987. The problem, warns David L. Taylor of Integrated Logic Systems Inc., Colorado Springs, is that gate-array chips are just too large.

Taylor uses the following numbers to back up his concern: Assuming that the average selling price of chips is about $20 each, the industry will need to produce 50 million chips to hit the $1 billion mark. With die sizes running as large as 160,000 mils^2, Taylor believes one wafer will produce no more than 20 good parts. That would require about 2.5 million wafers, which would have to be processed by fab lines with class 100 ratings (meaning 100 particles measuring 0.5 μm or less per ft^3). According to Taylor, there are less than 25 such lines in operation in the world, producing only 200,000 chips a year.

"An 80,000-mils^2 product might yield 20 to 25 good chips per wafer and a 160,000-mils^2 product only five per wafer," he estimates. "To produce on the order of 50 million semicustom products utilizing chips of this size would require in excess of the world's capacity for 16-K and 64-K dynamic random-access memories combined!"

Instead of pouring more money into finer processing technologies, Taylor maintains that the industry will have to turn to new semicustom logic architectures. That, he says, is what ILSI is doing.

The new architecture, to be used on ILSI's family of performance-programmable logic arrays, is slated to be tested next month when the firm begins prototyping a 6,000-gate complementary-MOS master slice. The chips will be processed in 3-μm technology, but the architecture will result in dies smaller than 2 μm, he says. The $5 million spin-off from nearby United Technologies Microelectronics Center expects to see a two-times area reduction from what it believes is a revolutionary design layout.

Taylor declines to describe the patented architecture but says it is as different from standard array layouts as static RAMs are from dynamic memories. The arrays will allow users to fine-tune critical speed paths and power consumption of circuits.

–J. Robert Lineback

Systems. His firm is employing a new architecture to trim the size of its performance programmable logic arrays (see "Start-up warns of logic-chip shortage," above).

Still many disagree, and a few suggest that overcapacity could touch off a semicustom logic shakeout after 1985. Many believe the number of different gate array product families will be reduced as suppliers continue to ink second-source pacts.

"I think it is getting to the point that it is evening out as all of the new fab modules come on stream this year," says Brian T. Sullivan, director of semicustom marketing at American Microsystems Inc. of Santa Clara, Calif. "The reduction of gate arrays is a main area of emphasis but it is not driven by the capacity fears. Instead, it is an attempt to make them more cost-effective and build larger dies." AMI is offering software that allows customers to automatically switch gate array designs to smaller standard cell chips when volumes grow.

Increased emphasis in semicustom markets by major chip houses will also have its impact on supply, says Ron Livingston, program marketing director for semicustom chips at National Semiconductor Corp. in Santa Clara. "We [the industry] will be building more facilities that will tend to produce higher yields," he says, citing National's new Arlington, Texas, plant running MOS wafers 6 in. in diameter. National is also in the process of shrinking its array technology from 3 to 2 μm.

"Software is getting better. So, the amount of wiring channels in the array can be diminished and the die reduced," he says. "I know when we first started out, we were telling customers that about 80% of the cells could be utilized. Now we are routing more than 90%, and on an experimental basis, we have come very close to 100% routed automatically."

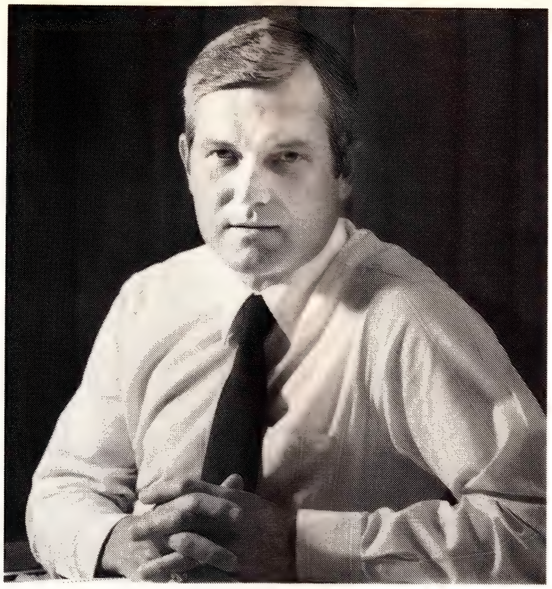
Slimming down. Mostek Corp. in Carrollton, Texas, is working on a 2-μm CMOS process for gate arrays to be introduced later this year. It will achieve an area allotment of 15 to 18 mils squared per wireable circuit, compared to an industry average of about 30 mils squared using 3-μm technology, says Richard Blumberg, gate array engineering manager.

In addition to the smaller geometries, Mostek is moving to a new back-to-back silicon structure for rows of gates in the array. The current 3-μm parts have rows of silicon cells separated by wiring channels. Blumberg says, "The back-to-back layout allows wiring of hardwired macrocells without blocking wiring channels." (Older array layouts often had additional wiring pathways to compensate for the possibility of blocked channels.)

Through with channels. In San Jose, California Devices Inc. is using an architecture without wiring channels in its double-level metal arrays to reduce die sizes by up to 1.5 to 2 times that of its nearest competitors. Jaime Martin, strategic marketing manager, says the entire core area is active, allowing high-density packing of gates. The firm is making master slices with 900 to 4,600 gates. A 3,600-gate array allots 19.2 mils squared for each gate.

Martin believes standard cell technology is more likely to affect full custom segments of the chip business than gate arrays. "Standard cells are more cost-effective in higher volumes, but the integration of more logic onto a single chip will actually lower volumes on a single design. So many times volumes will not be high enough to justify standard cells."

Gate arrays and standard cell technology may be merged in the future to offer quick turnaround on some portions of semicustom chips and tighter packing densities on other areas, suggests Russ Knapp, CMOS gate array program manager at Signetics Corp. in Sunnyvale, Calif. "We will not always think of gate arrays and standard cells being exclusive from each other," he says. The Philips subsidiary produces both gate arrays and standard cells in a 3-μm process and its Flexx array in a 2.5-μm process.



Forewarner. Gate-arrray makers must shrink their chips by using better architectures to avoid a capacity shortage, warns David L. Taylor, president of Integrated Logic Systems.

Monolithic Memories Inc. of Sunnyvale, Calif.—which this month signed a second-source pact to produce bipolar and CMOS gate arrays from Fujitsu Ltd. of Japan—is working on a semicustom chip approach that links its fuse-programmable array logic chips, called PALs, with mask-programmable gate arrays. "The approach will allow you to start from a PAL for prototyping and then graduate to volume production with gate arrays," explains Shlomo Waser, director of advanced product planning. A product introduction is slated by the end of 1984.

Even more. Low-density logic arrays—99 to 180 gates—are being aimed at competing with emerging user-programable logic devices at Universal Semiconductor Inc. in San Jose, Calif. The firm is calling the small parts CHUMs, standing for CMOS high-speed universal microarrays. "The PALs can be replaced by CHUMs," says George A. Stephan, president. "PALs are all right for prototyping but they can be expensive to program by semiconductor price standards."

Universal Semiconductor applies a read-only-memory programming technique to gate arrays. This reduces the need for wiring channels because cells can be personalized with source and drain contacts.

In Germany, Munich-based Siemens AG hopes to produce a CMOS array with about 20,000 gates by increasing the number of metal layers from two to three. In Japan, most chip makers will rely on aggressive processing programs to match demand and boost densities.

Fujitsu and NEC Corp. believe array implementation of semicustom designs remain competitive with standard cells at the 100,000-piece volume levels. Many U.S. suppliers believe designs should be converted to standard cell technology once annual volumes pass 25,000.

The short turnaround cycles of gate arrays are most attractive to semicustom chip users, says Akira Honma, manager of engineering at the Fujitsu Buhin Shoji Ltd. subsidiary. He says Fujitsu will mostly count on production increases to handle growth in the late 1980s.

NEC will likely use 1.5-μm design rules to boost density to 20,000 gates in two years, says Hiromichi Kimura, manager of the firm's integrated-circuit engineering department.

Toshiba Corp. will soon announce a new process that yields smaller geometries for gate arrays, but Seishi Okamoto, manager of the Industrial Semiconductor Application Engineering Department, notes finer line widths will not always make chips cheaper because the number of input/output pins is becoming the prime factor in costs at higher densities. He says a 3,000-gate array can require 150 pins, for example. Oki Semiconductor expects to use near 1-μm design rules to produce a 20,000-gate array by the end of 1985, says Shaukat Anjarwala, U.S. applications supervisor for semicustom parts. **–J. Robert Lineback**

CITIES

Another boom could be near for high tech in San Antonio

San Antonio, Texas—Motorola Inc. has begun studying ground-core samples from two parcels of land here with the hope of locating a major semiconductor fabrication facility on the city's northwest side. Disclosure of Motorola's option on the 80- and 95-acre tracts has heightened speculation that San Antonio is again going to stick its thumb into the high-technology pie and pull out the plum of new electronics plants.

Located 60 miles southwest of Austin, the Texas capital and one of the most publicized hotbeds of U.S. electronics, San Antonio is the nation's 10th largest city and has actively recruited high-technology companies since the late 1970s. "But like most cities, we were not immune to recessions," says Leo Zuniga, vice president of the San Antonio Economic Development Foundation, a nonprofit organization helping firms locate in the Alamo City.

"Now I think we are regaining the momentum we had going for us in 1981," adds Zuniga. The period from 1979 to 1981 was a good time for the city. First Harris Corp. moved into a new telecommunications manufacturing facility, then Magnetic Peripherals Inc., a subsidiary of Control Data Corp., opened a plant. In 1981, San Antonio racked up victories when it was selected as the site for new plant locations by Sprague Electric Co., Advanced Micro Devices Inc., and Tandy Corp. Then the recession stalled further action, laments Zuniga.

Hot times again. But things are heating up again in the city, which is also a commercial hub with its two nearby Air Force bases as well as the the Army's Ft. Sam Houston. What's more, it boasts a combination of old Mexican charm and 1980s spirit. Last December, Isotronics Inc., New Bedford, Mass., broke ground for a new 40,000-ft^2 electronics packaging plant. In the spring, AMD increased its bipolar front-end facility by 212,000 ft^2. And this summer, Control Data has completed a 100,000-ft^2 addition to its San Antonio operation.

Motorola declines to speculate on just which chip technology or products will be processed in San Antonio, but many officials with the firm's MOS operation in Austin believe it will be MOS. In addition, Zuniga expects three more announcements before the end of September, including one by an electronics firm. –**J. Robert Lineback**

COMPONENTS

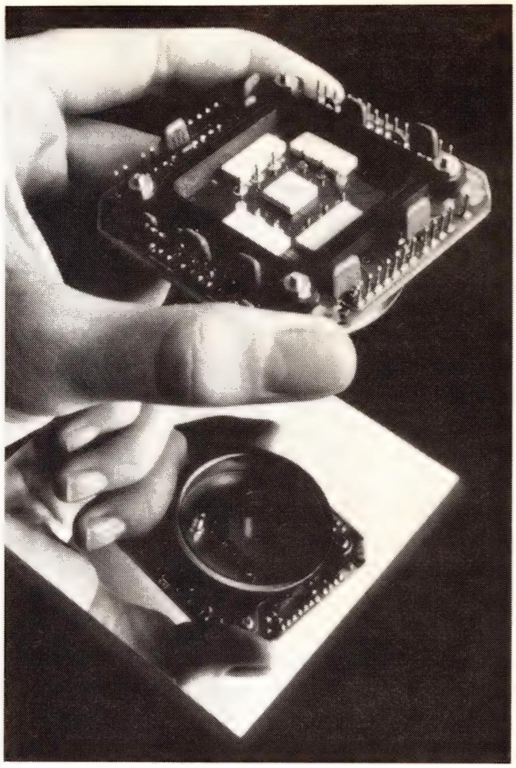
Tektronix jumps into hybrid market

Beaverton, Ore.—The 350 or so U.S. companies sharing through thick or thin the $3.5 billion market for hybrid circuits have just gained a formidable competitor: Tektronix Inc. The big instrumentation firm has decided to enter the custom hybrid market using the people and facilities of its own large Hybrid Component Operation.

Thus the independent hybrid microelectronic firms suddenly have to face the equivalent of a giant company with a staff of 70 hybrid designers, support from a custom integrated-circuit facility, a ceramic manufacturing facility, a complete computer-aided design base, facilities for laser trimming and fully automatic testing, large production facilities, and a capability to turn a custom unit around in between 8 to 12 weeks.

Tektronix will sell only to the commercial-equipment makers, leaving the military market—generally considered to account for 45% of the total—to the established players. Its hybrid operation will address such high-technology segments of the hybrid field as instrumentation, telecommunications, computers and computer peripherals, and the more complex units needed in the industrial field.

Robert Stanton, marketing manager for the operation, feels that Tektronix has a special advantage since it can handle a range of operations—such as the possibility of both thick- and thin-film, chip-and-wire construction, surface-mounted assembly on both alumina and printed-circuit substrates, and passive and active laser trim—that are rarely all found at a single independent hybrid fabricator. In addition, the unit has considerable experience in designing special high-frequency and high-power hybrids and within the last few years has gained expertise in mixing hybrid and fiber-optic technologies.


Available. Tektronix is opening up its extensive in-house hybrid circuits operation, which turns out parts like this thin-film a-d converter, to outside customers.

The Hybrid Component Operation had been used only for in-house design and production of a wide range of hybrids for its oscilloscopes, instruments, automatic test equipment, and displays. Its powerful CAD base gives it another advantage over smaller independents in laying out artwork, partitioning circuits, doing thermal modeling, and selecting components. –**Jerry Lyman**

STRATEGIES

CMOS start-up tries to raise money and attract customers by exchanging long-term fabrication deals for capital

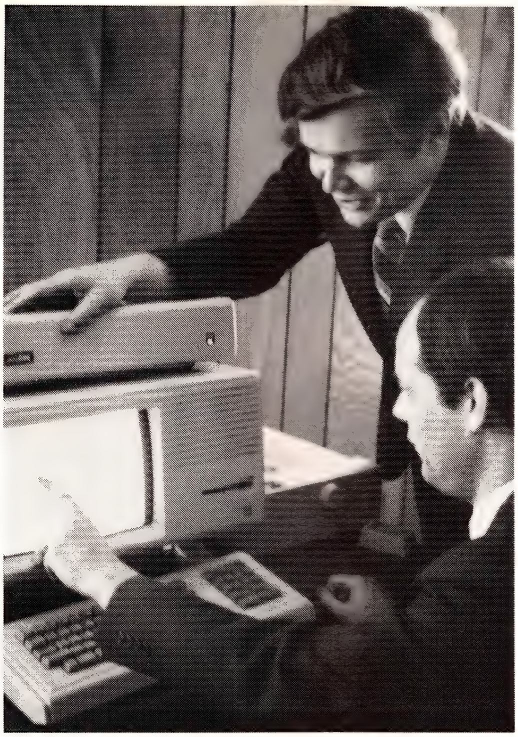
Minneapolis—By pursuing a funding path that may be unique among semiconductor start-ups, the founders of a two-month-old company here, VHSIC Technology Corp. (VTC), hope to hang onto more equity and at the same time raise more money than they could ever hope to get in a conventional venture-funding deal. Their strategy is to seek to exchange long-term fabrication commitments for corporate funding of their efforts.

Already staked with a $10 million investment pledge from Control Data Corp., the fledgling firm hopes to raise $70 million to $120 million to build a state-of-the-art CMOS plant. Its effort comes at a time when many semiconductor start-ups are essentially design houses that rely on silicon foundries for production, and in fact may never have fabrication capabilities of their own.

While venture capitalists will typically provide only a few million dollars, at most, for initial seed money, officials at VTC figure they can raise much more money from corporations. VTC hopes to negotiate deals similar to the one signed with Control Data with additional corporate sponsors that, like CDC, will not only get an equity share in the company but also a guaranteed long-term commitment that VTC will build chips for the sponsor.

For the sponsors, the arrangement means a guaranteed source of supply without having to provide their own fabrication capacity, explains VTC president Thomas Hendrickson. For his company, what the executive calls the "guaranteed revenue stream" means the firm can much more easily go out and obtain bank financing and other conventional forms of funding, he maintains.

"The foundry operations I'm aware of today are unwilling to commit to long-term production," and can dry up as a source for systems houses when the chip market gets hot, Hendrickson contends. By contrast, VTC will assure Control Data of a certain portion of its capacity for a minimum of five years, and perhaps up to 15 years, pending final negotiation, he explains.



Blueprint. VTC founders Thomas Hendrickson and John R. Hodgson believe their guaranteed-capacity-for-cash strategy is the key to success in the market.

Attractive deal. Harry Ashbridge, CDC vice president for business ventures, agrees that the prospect of a long-term assured chip supply was a major selling point for his company. Even though the firm has not had specific chip-supply problems with merchant foundries that have delayed any programs, says Ashbridge, that may not always be the case. The nature of the semiconductor business points toward a potential for such problems down the road, he notes. Like VTC officials, Ashbridge stresses that Control Data's investment in the start-up represents only a minority interest, and is similar to a number of other technology investments made by CDC.

The new firm will start out using CDC's microcircuits facility in Bloomington, Minn., but plans to break ground this fall for its own plant at a yet-to-be-determined site. Production of 1.25-μm CMOS logic integrated circuits is planned to begin at that plant in early 1986, says VTC executive vice president John R. Hodgson.

Sites are currently being considered in four states, he adds. Plans call for use of 5× step-and-repeat projection lithography systems, dry processing, and 5-inch wafers initially, with conversion to 6-in. wafers in early 1987.

Cofounders Hodgson and Hendrickson are former managers at Fairchild Camera & Instrument Corp.'s digital products division, in South Portland, Me. Both had experience with Fairchild's successful FAST bipolar logic line there. Also, Hendrickson had spent nine years at Honeywell Inc., gaining engineering management experience in a number of fabrication technologies including 1.25-μm CMOS.

Hendrickson says that more than 90% of VTC's initial production will go toward dedicated custom logic chips supplied to its corporate investors. But by the late 1980s, he expects the firm to be selling at least 50% to 60% of its production to the open market, both commercial and military.

The product line will include selected very-high-performance CMOS logic standard products, as well as both military-hardened and nonhardened versions. Also offered will be semicustom standard cell products. "We will not be involved in gate arrays unless our investors want them processed for their own use," says Hodgson.

At Sequoia Capital, a Menlo Park, Calif., venture-capital partnership, general partner Donald Valentine notes that the VTC plan sounds like "a good strategy, but executing it is the key. This kind of approach has been tried three or four times before, and from my view never very successfully."

Meeting sponsor demands. Stumbling blocks can include the fragmentation of production efforts because of the need to meet production needs that may be peculiar to each of the various corporate investors, Valentine observes. In addition, "being tied into the dictates and the success of your sponsors" can lead to "an incompatible process that is not competitive with the merchant suppliers," he says.

VTC officials profess no worry over such problems, however. Contracts with corporate sponsors will specify processes to be used over a five-year plan so that "we all know what we're going to build," Hendrickson says. And he notes that no individual corporate sponsor will be able to dictate VTC's direction since each will be granted only one seat on the start-up's board with a single vote. **–Wesley R. Iversen**

COMPUTER GRAPHICS

Video-controller IC ups system power

Houston—Now in sight for computer-system designers is a video-controller chip that is expected to effectively double the processing power of host microprocessors by taking over 95% of the overhead functions required in high-resolution bit-mapped graphic systems.

Nearing the end of its development at Texas Instruments Inc., the chip is fabricated using a 2.4-μm high-performance n-channel MOS process. The 68-pin controller, disclosed at last week's Siggraph 84

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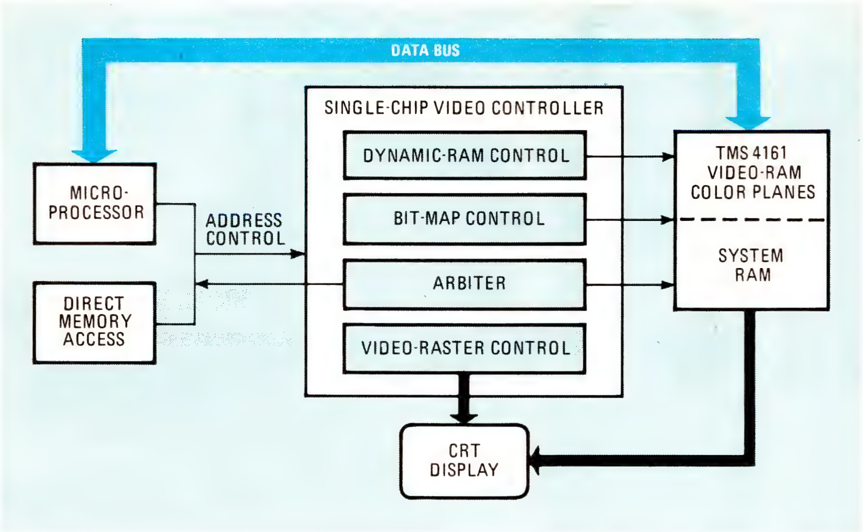


Power up. TI's video chip, for CAD work stations and personal computers with high-resolution graphics, gives direct access to 1 megaword of RAM. It handles nearly all overhead functions, doubling the host's power.

conference in Minneapolis, Minn., is intended to be teamed with TI's TMS4161 multiport video random-access memory chip slated for an August introduction.

Shifting. The new controller has been designed to exploit the video RAM's internal shift register and the serial ports. The video memory consists of a dynamic-memory block and an internal shift register. Data from the 64-K-by-1-bit dynamic memory can be transferred in parallel, 256 bits at a time, from the array to an internal 256-bit shift register. It is shifted in and out of the on-chip register through dual serial ports.

Both the control and the memory chips are targeted at high-resolution displays in personal computers as well as in computer-aided design work stations. The new parts will dramatically reduce the need for glue logic in video subsystems, while almost halving the time host processors spend updating and refreshing bit-mapped displays, says Mike van Bavel, program manager for TI's video and control products in Houston.

"We have talked to a lot of video subsystem designers, and one of the key things they kept coming up with was a need for a dual-ported video RAM to eliminate bottlenecks," he says. "The next step is to have a controller that allows the benefits without extra glue logic."

With conventional single-ported dynamic RAM, a central host processor must spend about 50% of its processing time on updating and refreshing the display, van Bavel says. With video RAM, update and refresh occur simultaneously.

The video controller, which will come in 68-pin plastic leaded chip-carriers, has on-board interface logic to work with a wide range of microprocessor types. Any processor running at clock speeds up to 10 MHz can be used as the host.

Typically, the video controller will reside along the data bus, tapping off 8 bits for its commands to set programmable internal registers. This arrangement lets designers make the video subsystem any bandwidth.

The controller arbitrates between host and video refresh cycles and provides direct access to 1 megaword of RAM (with word size depending on the size of the host). Besides functioning as a raster-video controller, it handles sync and blanking signals for monitors as well as links video information with the computer-generated display. **–J. Robert Lineback**

TRADE

EIA is moving closer to seeking broad Japanese telecom sanctions

Washington D.C.—Heartened by the latest Commerce Department move against a Japanese telecommunications supplier on dumping charges, the Electronic Industries Association may now take matters into its own hands. The EIA's Telecommunications Group may soon call for trade sanctions that could result in across-the-board tariff hikes on all Japanese telecommunications equipment shipped to the U.S.

The EIA hailed the department's preliminary determination in mid-June that Kokusai Electric Co. is indeed selling cellular-phone base-station transceivers in the U.S for 40% of their true cost. The charge was formally levied by E.F. Johnson Co. [*Electronics,* Jan. 12, 1984, p. 70]. The preliminary finding will lead to a final recommendation to the International Trade Commission in late September.

John J. McDonnell, vice president of the EIA's Telecommunications Group, called the decision "another positive step in our effort to bring a '301' trade suit against the Japanese telecommunications industry." These suits get their nickname from a provision of the 1974 Trade Act, which allows U.S. industries that have been hurt by unfair foreign competition to seek relief from the U.S. government. Such relief could range from higher tariffs levied on foreign-made products to the opening of protected foreign markets.

To get industrywide import relief under the 1974 Trade Act, the EIA would have to demonstrate that the Japanese government has deliberately encouraged its telecommunications sector to target U.S. markets through such unfair practices as dumping, explains McDonnell. The Office of the Special Trade Representative would be responsible for investigating such charges and for recommending remedial measures.

Action hard. Admittedly, 301 actions are very difficult to prove, says McDonnell. Currently, his group's arsenal contains ample evidence of Tokyo's role in fostering telecommunications development domestically, but it has only three examples of Japanese market penetration resulting from unfair trade:

- An antidumping action, involving pocket pagers, that Motorola Inc. won last year.
- A pending patent violation charge concerning optical fibers that Corning Glass Co. brought against Sumitomo Electric Industries.
- E.F. Johnson's case against Kokusai, in which the Waseca, Minn., radio maker seems headed for victory.

Three cases are hardly enough to launch, let alone win, a 301 action, but McDonnell claims to have more potential supporting cases in the wings, at various stages of development. At this time, he does not know which of the cases really represent legitimate 301 material and which are merely sour grape actions by firms that lost business to legitimate Japanese competitors. Either way, EIA will decide to move forward or to drop its complaint by October, he reports.

If enough material can be found, the association may not have to do more than threaten to play the sanctions card, hints McDonnell. The Semiconductor Industry Association went down the same path a year ago. Just when it announced its intention to file for 301 relief, Washington and Tokyo signed an agreement to eliminate tariffs on semiconductors and to improve statistical monitoring techniques [*Electronics*, Dec. 1, 1983, p. 62].

The same tactic could work for the U.S. telecommunications industry. Thomas Howell, the attorney in the case, thinks that pushing a 301 through would serve EIA's interests. "We have seen an awful lot of formal agreements and liberalization attempts come and go, and yet U.S. manufacturers maintain only a marginal presence in Japanese markets."

Even if the evidence supports a filing, both Howell and McDonnell agree that the timing may be poor. The Japanese Diet's lower house recently passed a series of acts to privatize Nippon Telegraph & Telephone Public Corp. and to permit foreign firms to supply value-added network services to NTT and its future competitors. Tokyo could thus perceive a 301 filing as a slap in the face, they admit. **–Karen Berney**

INDUSTRIAL

I/O modules link factory controls

El Segundo, Calif.—International Rectifier Corp.'s Crydom division has opened the door to a multimillion-dollar industrial electronics market. With Phoenix Terminal Blocks Inc., Harrisburg, Pa., it has gone to market with input/output modules that link controllers to such equipment as robots, motors, and transformers. But instead of putting the modules near the microprocessor controller, Crydom puts them near the controlled equipment.

In conventional systems, the 5-V microprocessor output signal cannot travel more than a few feet without a boost, so the I/O modules must be nearby. Clutter reduces the possible interface points, and expensive No. 12 or 14 copper wire is needed to connect the I/O units with real-world jobs or external power loads.

A better interface system would put the modules at the loads, not the processor—sometimes at distances of more than 500 ft—"a different approach to the old problem," notes John D. Deith, Crydom's marketing vice president. Two months ago, engineers at the division found "an answer so obvious we couldn't believe no one had done it."

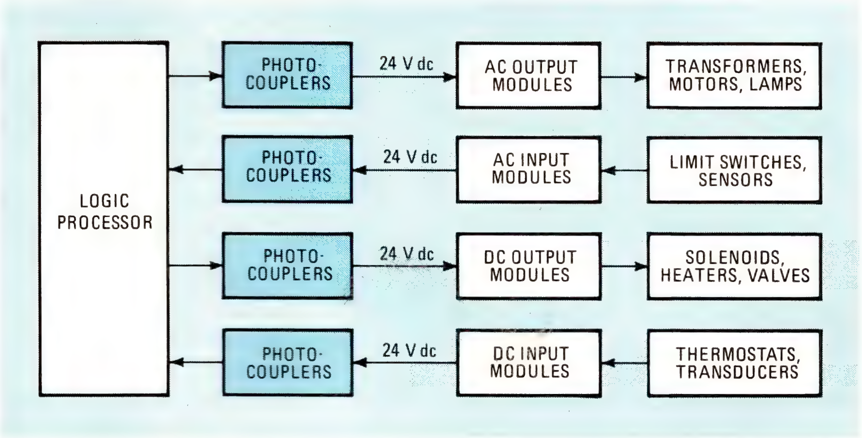
Instead of putting ac or dc switching modules near the processor, the Crydom team substituted a photocoupler, a light-emitting diode connected to a phototransistor (see diagram). "We activate the LED with the 5-V output from the microprocessor," Dieth explains. The phototransistor is connected in series with either a 24- or 48-V dc power supply and routed through low-voltage wiring to the remote I/O unit. Besides the savings from light wire, the technique cuts costs by using signals of less than 50 V. It avoids Underwriters Laboratories duct requirements, says Deith.

Crydom has not yet formally named its new product line, calling the new hardware "remote I/O modules" for the time being. Nonetheless, it has found a lively interest among its customers for conventional interfaces.

Mounting the modules presented a problem, since convenient attachment of remote units is important. Rail mounting, a common way of packaging electrical connections in Europe, proved to be the best solution. This technique fastens the modules on rail-like tracks.

Riding rails. To develop the I/O modules, Crydom has entered into a joint-venture arrangement with Phoenix Terminal Blocks, which patterns its products on the European rail-mounted model. The firm is also developing a surface-mounted unit that is suitable for attachment to cabinetry, where single or double I/O functions are needed.

One market for these units consists of home computers connected to remote sensors performing household jobs. The Pennsylvania company has come up with a packaged design for the modules, with separate circuit



Nearby. By putting photocouplers close to the microprocessor, control signals can be sent at "factory" voltage level of 24 or 48 V rather than the usual logic level of 5 V.

boards for input and output. Both Crydom and Phoenix will sell the modules, which cost $5 to $6 in quantities of 1,000 to 10,000.

The solid-state relay business now amounts to only $45 million a year but is expected to grow quickly with the advent of the new I/O modules. The potential is huge; 200 million I/O points alone are subject to upgrading. **–Larry Waller**

BUSINESS

Motorola is riding business wave

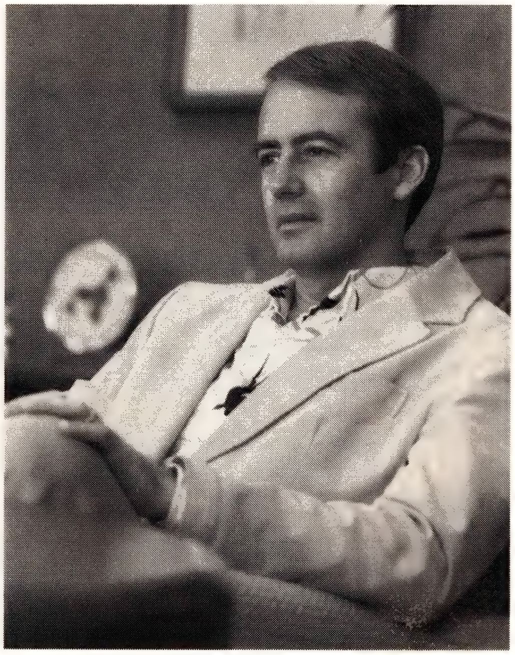
Chicago—As supplier of one of the broadest lines of components and equipment in the electronics industry, Motorola Inc. is riding high on the wave of business generated by the current economic upswing. As a result, the Schaumburg, Ill., firm can boast about record quarterly sales and earnings for its second quarter, ended June 30.

Second-quarter sales in 1984 jumped 36%, to $1.4 billion, from last year's $1.04 billion, while earnings for the period nearly doubled, to $98 million, from $51 million. For the first half of the year, earnings totaled $176 million on sales of $2.67 billion, up from last year's first-half earnings of $83 million on $1.98 billion in revenues.

Leading Motorola's surge is its semiconductor business, which has pushed the firm into a neck-and-neck race with Texas Instruments Inc. for the title of the industry's largest supplier. In all, president John Mitchell noted before a group of investment analysts here this month, Motorola's integrated-circuit revenues grew by 60% during the first six months of 1984 versus the same period last year, while discrete sales rose 40%.

Worries unfounded. Any worries about the recent drop in the industry's book-to-bill ratio [*ElectronicsWeek,* July 23, 1984, p. 24] to a level of some 1.12:1 and about the industry's health are unfounded, in Mitchell's opinion. Order levels remain high, he says, and reflect a chip replacement rate rather than the pipeline filling that took place in the last several months.

Glamour items in the Motorola semiconductor portfolio include the recently introduced 32-bit 68020 microprocessor, with which the firm expects to grab a major chunk of a projected $3.3 billion total available market for 16- and 32-bit processors by 1988. Shipments of the 68020 will probably exceed 100,000 units next year, says James R. Fiebiger, senior vice president and assistant general manager for Motorola's Semiconductor Products Sector.


No fears. Motorola's shipments of its 32-bit 68020 microprocessor could hit 100,000 units next year, thinks James R. Fiebiger.

Cellular radio, too, is a hot area in which Motorola leads the industry. "We've never had a communications business with anywhere near this type of explosive growth," exclaims Mitchell. Motorola has so far cemented 16 contracts within the top 30 U.S. cellular markets; these should be on the air by year end, says Ray Farmer, executive vice president and general manager for its Communications Sector.

Motorola does have a few businesses whose balance sheets are not so cheery, however. For example, its Four-Phase Systems Inc. subsidiary, acquired in 1982, remains unprofitable and has pulled down results for the firm's Information Systems Group, which also includes modem makers Codex Corp. and Universal Data Systems Inc. Four-Phase faces tough competition in the office automation business, primarily from IBM Corp.'s System/36 small business system, introduced last year. Motorola officials concede that IBM has gotten off to a rip-roaring start.

But Four-Phase has introduced more new products in the first half of this year than it did during the previous three years, officials point out. The conversion of Four-Phase's product line to 68000-based products as well as a new customer support operation in Dallas are among the factors that Motorola is counting on to pull the operation into the black.

Overall, Mitchell notes, the firm will continue to increase investments aggressively in its businesses, with capital spending rising as much as 50% this year, to over $700 million. Spending on research and development, meanwhile, is expected to top $400 million in 1984, up about 20% from last year. **–Wesley R. Iversen**

MEMORIES

U.S. RAM quality seen improving

Scottsdale, Ariz.—U. S. users of dynamic random-access memories are likely to believe that the quality of American RAMs is virtually equal to that of Japanese random-access memories. Such an opinion represents a strong comeback for U.S. firms, which have long toiled in the shadow of reported Japanese superiority on RAM quality [*Electronics,* April 10, 1980, p. 81].

A recent survey of U. S. dynamic-RAM buyers conducted by Integrated Circuit Engineering Corp., a Scottsdale, Ariz., research firm, confirms the change in attitude. But it also uncovers a substantial number of U. S. users who continue to believe that Japanese parts are of better quality.

Compiled from the responses of

more than 100 companies using dynamic RAMs, the survey found that 63% believe U.S. suppliers provide products whose quality is equal to, or even better than, parts sold by Japanese manufacturers. However, when the votes of those in the 63% who back the "equal" category are eliminated, respondents who think that the U.S. has better parts are outnumbered by those backing Japan by a 4:1 margin. The responses primarily come from design engineers and engineering managers, according to the ICE report, presented in its July newsletter.

The Scottsdale company concludes that, in general, "the Japanese are perceived as having superior quality DRAM components," even though the U.S. suppliers have certainly made much progress in improving quality levels. "Definitely unjustified," says ICE, is a blanket assertion that "all Japanese DRAM producers supply better quality than any U. S. DRAM manufacturer."

ICE, which tracks the quality issue closely by reading Japanese industry trade publications, concedes there is some basis for the perceived Japanese superiority regarding dynamic RAMs. But it points out that this is not true for other products, such as microprocessors, semicustom chips, and various forms of programmable read-only memories, where U.S. suppliers are widening a technology lead in worldwide competition.

The Arizona firm's survey, conducted during April, concerned the future of the 64- and 256-K dynamic-RAM markets. It also included one question about U. S.-Japanese device quality, and this was the basis for its report on users' perceptions of quality. **–Larry Waller**

SEMICONDUCTORS

Rockwell, in new approach, plans full CMOS peripheral family

Los Angeles—Having converted its mainstay n-channel 6500 processor line to CMOS technology, Rockwell International Corp.'s Semiconductor Products Division now plans to address what it believes is a hitherto unexploited market niche—standard peripheral chips for 8-bit CMOS microprocessors. The firm will implement its blueprint with a fully developed family to support its R65C02 processor.

This strategy of planning an entire family of products at the beginning rather than introducing one chip at a time presents some pitfalls, points out Roger B. Helmick, manager of market development at the Newport Beach, Calif., division. "The risk is getting to the market at the same time with them," he says.

Paying off. However, Rockwell's semiconductor operation, whose conversion of the 6500 line to CMOS was hampered by design and production delays in 1982 and 1983, now has the R65C02 and four peripheral chips in volume production. Moreover, the months of heavy direct sales efforts and of putting sample parts in prospective buyers' hands is paying off "with quite a customer inquiry rate," and several important contracts, according to Helmick.

Bringing out a CMOS family of parts "is a good strategy to have," in the opinion of James Feldhan, a vice president with semiconductor market consultant In-Stat Inc., Scottsdale, Ariz. "The more devices, the better," he says.

Mixing CMOS processors with n-MOS peripheral chips works against "getting the true low power and speed advantages of CMOS, especially for portable and power backup equipment," he notes. While the CMOS business is still much smaller than n-MOS, sales are growing at about twice n-MOS's rate.

Other semiconductor firms are pursuing the chip-family approach, Feldhan points out. These include CMOS leader National Semiconductor Corp., and GTE Corp.'s Microcircuits Division, Tempe, Ariz.,

Gathering MOS. The strategy of Rockwell's Semiconductor Products division of bringing a full family of CMOS peripheral chips to the market during a time of shortages entails some risks but also offers much potential, thinks Roger B. Helmick, manager of market development.

AAAI's 1984 conference captures industry interest

Interest in artificial intelligence research is reaching a new level as more and more corporations scramble to apply AI theory to expert systems. In fact, this year's National Conference on Artificial Intelligence, slated for August 6-10 at the University of Texas at Austin, will be the largest meeting yet in this field. Already, preregistration figures nearly match the 2,400 who attended last year's conference in Washington, D.C., and hundreds are expected to register on site.

Sponsored annually since 1980 by the American Association for Artificial Intelligence of Menlo Park, Calif., the conferences were at the outset regarded as mostly for academics, but the last two years have shown a change in the kind of people attending. "This has gone completely beyond the wildest dreams of the [association's] founders," says Jay M. Tenenbaum, the conference chairman. "Every major company has a person tracking the AI field. There is tremendous commercial interest now."

In a bow to the heavy influx of industry attendees, this year's conference will have a change in format. There will be tutorials of a less technical nature, such as fundamentals of building expert systems and Lisp programming. Presentations of technical papers are concentrated in sessions on the second and third days of the meeting. At these sessions, researchers can benefit from conferring with colleagues on special topics ranging from knowledge representation to speech recognition and to cognitive modeling.

Automated reasoning has attracted the greatest number of papers on a single topic. "What you're seeing is research pushing the frontier to a much more principled way to represent reasoning...making the machine able to observe the world directly with less reliance on the human input," says Tenenbaum.

Program chairman Ronald J. Brachman touts the panel sessions on the last two days of the conference as "a thought-provoking counterpoint to the technical-paper sessions." Of particular interest is the Friday session on "DARPA's Strategic Computing Project: Challenges and Changes for AI." A Thursday session on "AI in the Marketplace: Issues in Transfer of AI Technology to Products" will feature seven industry panelists.

With the heavy industry attendance, Tenenbaum believes his association is witnessing an evolution similar to that experienced by the Institute of Electrical and Electronics Engineers, where the organization serves both scholarly and trade interests. He says that in time, the AAAI annual conference may have to be split into separate trade and research conferences. **–Eve Bennett**

which has a licensing agreement with Rockwell. (NCR Corp. also has a second-source pact for the Rockwell CMOS line.)

The Rockwell R65C02 is compatible with the n-channel line, but adds such enhancements as bit manipulation and a 4-MHz high-speed version, in addition to the low power drain of 4 mA/MHz. Most customers will be able to replace the 8-bit 6500 with an equivalent-speed CMOS processor without redesigning their boards, Helmick says. The cost of the change would be approximately 20% higher per MHz, depending on quantity.

First products. The initial peripherals are the R65C21 interface adapter, for control functions; the R65C24, which adds a 16-bit timer for more complex tasks; and the R65C51 asynchronous communications unit, for interfacing a processor and serial data sets and modems. The latest support chip to go into production is the R65C52, which is a dual version of the R65C51 that permits both transmitting and receiving at the same rates. Now at the sampling stage are two memory parts, a 150-ns 64-K random-access memory and a 350-ns 64-K electrically erasable ROM.

Customers already are asking for more parts, specifically controllers for floppy disks and cathode ray tubes. These are key devices needed to improve lap-type battery-powered computers. "If you use one on a coast-to-coast flight, they run out of power along about Kansas City," Helmick observes. Rockwell is considering whether to produce these chips. As for 16-bit CMOS processors, no definite plans are yet in the works. **–Larry Waller**

AI COMPUTERS

Fujitsu set to ship fast Lisp machine

Kawasaki, Japan—Artificial-intelligence researchers in Japan will be able to avail themselves of what is claimed as the world's fastest Lisp machine when Fujitsu Ltd. starts shipping its Facom Alpha next March. The machine [*Electronics,* March 24, 1983, p. 71] is said to be four times faster than Symbolics Ltd.'s Lisp machine, yet it costs only $90,500, plus about $13,000 for Lisp software. The price reflects the new machine's function as a back-end processor intended for use with Fujitsu's mainframe computers and with the firm's Facom S-3000 series of superminicomputers.

Dedicated unit. Researchers can continue to use the familiar interface of the host computer's timesharing system together with its data base, Japanese-language processing facilities, and other programs. But the actual Lisp language processing, which tends to strain the capacity of general-purpose computers, is offloaded onto the dedicated processor, leaving the host computer free to perform other operations.

The company says that several Alpha processors can be connected to a single host to provide extremely high computing capacity. The reason is that even a single Alpha has roughly the same throughput as a large mainframe, Fujitsu claims. Moreover, in annoucing the machine, the company said that hardware to tailor Alpha for Lisp would include a 16-kiloword-by-32-bit hardware stack for high-speed access to data.

The language implemented by Fujitsu is called Utilisp, a Maclisp look-alike developed at the University of

Real dedication. AI researchers processing the Lisp language can offload their work to the dedicated Fujitsu Facom Alpha processor in the background, leaving the host computer free to perform other operations.

Tokyo. Maclisp is a dialect developed at the Massachusetts Institute of Technology and is fairly well known in Japan because it is readily available for Digital Equipment Corp. minicomputers, a popular machine among researchers.

Fujitsu says that sometime next year it will also start shipping software that will enable an Alpha to process Prolog, a new language that is being used in the nation's fifth-generation computer project favored by many Japanese AI researchers.

At present, Fujitsu has no concrete plans to export the Alpha processor, although the company might adapt it for mainframes sold by Amdahl Corp., Sunnyvale, Calif., in which Fujitsu owns a controlling interest. A more attractive option is to bundle it with a Fujitsu mainframe or superminicomputer, which would eliminate the need to keep tabs on changes in the operating system of another company's computers. But Fujitsu might have to support application software or otherwise help keep the host busy because the Alpha processor imposes very little load on the host. –**Charles L. Cohen**

INDUSTRIAL ELECTRONICS

Machine-vision maker sees industrial inspection rather than robots as its major market

Manchester, N.H.—So much has been written and said about robots recently that a new industry—machine vision—has emerged almost unnoticed. Often considered just an adjunct to robotics, machine vision has in fact found its most important outlet to date in the area of industrial inspection.

This fact accounts for the rapid growth projected for Itran Corp., a start-up company that has been manufacturing machine-vision systems for industrial inspection for some 18 months. Itran's sales should be about $3 million for 1984.

The firm's vice president for finance and administration, Lynn Kapeghian, predicts annual sales increases of 100% through 1988, with 95% coming from industrial inspection and 5% from robotics. With an industrywide sales total of about $60 million in 1984, there is ample potential for hefty profits in industrial inspection, even though robotics applications are expected to increase. Explains Stanley Lapidus, Itran's president, "Machine-vision technology grew out of several image processing fields and has so many manufacturing applications that it will pervade almost every industry."

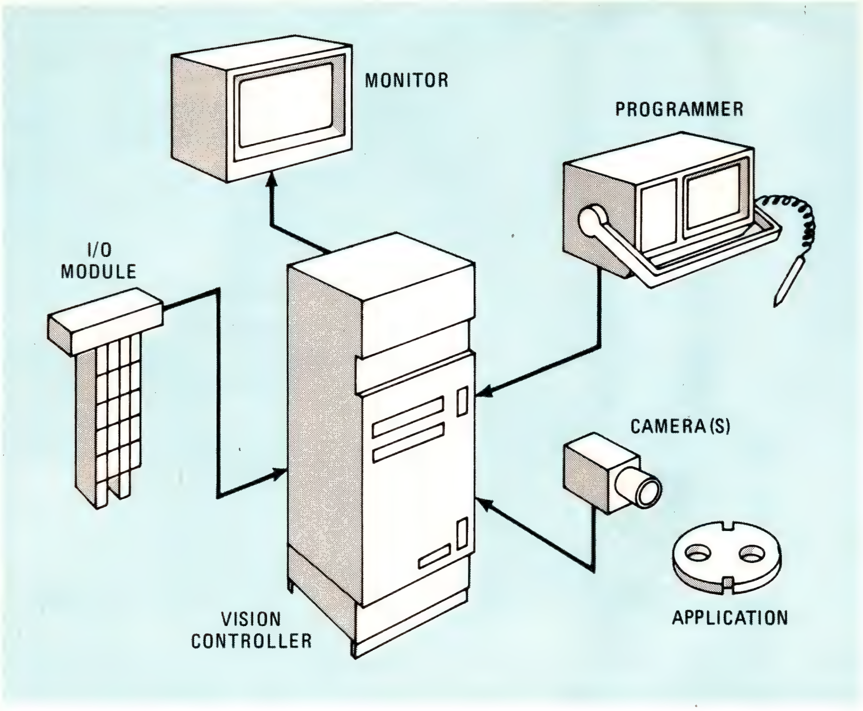
Bread and butter. For the moment, the firm's sales are coming mostly from its Itran 8000 Vision Controller, priced at about $60,000 for a complete system. It has five components: a camera, a monitor, an input/output port, a portable programmer, and the vision controller itself (see figure).

The controller is the system's heart, programmed using a terminal and plain-language (ladder logic in English) statements selected by a light pen. Each statement is displayed in menu style and is color-coded according to functionality, such as titles, specific instructions, procedural guidelines, and the like.

"Applications requiring multiple cameras are easily accommodated," says Seymour Friedel, the firm's vice president for engineering. "Hardware is provided in the vision controller that will accept up to eight cameras. Multiple camera installations are used either to view several sections of a large object simultaneously or to look at separate applications at different plant locations."

Friedel says there are two key points in machine vision: gray-scale imaging and edge detection. Because a camera, regardless of its resolution, sees an image in terms of pixels, it becomes the task of the computer in a machine-vision system to give each pixel a unique value and then process these values to store a visual image accurately in the language of the computer.

There are different approaches to what should be done with this infor-



Visionary. Itran can see a range of industrial applications for its modular vision inspection system, whose controller is built around a Motorola 68010 microprocessor.

mation. Some manufacturers of machine-vision equipment use a technique called global thresholding, whereby a value of "black" is assigned to all pixels below a certain intensity and "white" to all pixels above it. Another common technique, called local windowing, permits different threshold values to be assigned to different areas of a scene. This approach lets specific areas get special attention.

Itran's technique is called gray scaling, which processes each pixel by assigning it a value from 1 to 64, corresponding to the intensity of the light transmitted by the camera. Each pixel is resolved with 6 bits of information, which are processed by a Motorola 68010 microprocessor according to the pattern-recognition algorithms that Itran adapts for the needs of end users.

Well adapted. Custom adaptation of the algorithms also plays a role in edge detection. "Edge detection is a much more complicated issue than gray scaling because it is difficult to quantify," Lapidus maintains. "If you look at the corner of a room, how do you know it is a corner? Is it the foreshortening of the walls? Is it that the corner itself is darker than the walls? Is one wall darker than another? The same questions apply to recognizing different features of a piece of machinery that you want to inspect for defects."

Itran has restricted itself to certain well-established algorithms that it has adapted to its 8000 system but that let the user define the points by which an object is placed on an assembly line. Three points define the object's position, while a raster of 320 by 240 points is stored to be matched against possible defects.

Most industrial inspections involve moving objects, so the system can be programmed to favor the recognition of either outside edges or a finer internal detail. Objects like cola bottles are simply edge-detected and can be inspected quickly and in quantity.

A more complicated object, like a car's speedometer, has to be evaluated both in terms of its edges and the gray-scale intensity of its features. Itran designed the 8000 to perform both functions by means of a parallel bit-slice processor.

"Right now, an assembly line of speedometers can be inspected faster than a human could do it, and there are a lot of products like that on the market," says Friedel. "We expect to sell as many inspection systems as we can make." **–David M. Weber**

ROBOTS

Brazilian firms launch robot with 100% in-house technology.

São Paulo—The first robot designed entirely by Brazilians is coming from Engemaq Indústria de Maquinas Ltda. and BCM Engenharia Ltda. Engemaq, in Caxias do Sul, Rio Grande do Sul, developed the robot's mechanisms. BCM, in Porto Alegre, Rio Grande do Sul, developed the software and the controller, based on a Z8 microprocessor.

The robot, a mechanical arm, has freedom of movement in five axes and pneumatic control. The gripper uses numerical control to get within millimeters of the object to be gripped, and inertia carries it onward until it bumps into an obstacle placed so as to guide the gripper into exactly the position that is required by the application.

This simplicity keeps the system's final price within reach of the Brazilian market. The robot is programmed in a multitasking language based on Portuguese, says José Luiz Bozzetto, a director of BCM. The machine will sell for $12,000.

BCM is in the initial stages of approaching the government's Research Institute for the Computer-Related Industries (CTI), at Campinas, with a view to cooperation. The CTI is charged with developing an indigenous robot technology.

Earlier this year, Volkswagen gave the institute a German-made K-15 automobile-fabrication robot, which will be studied and eventually used as the basis of local developments [*Electronics,* Jan. 12, 1984, p. 75]. BCM is working on a larger and more sophisticated robot, which will be able to handle soldering and welding. **–Rik Turner**

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Sadly, although huge strides have been taken recently, the fight isn't over. But hopefully our involvement in the fight against the diseases has just begun. Once again, Hamilton/Avnet is sending out the rallying call to the entire electronics industry to join us in the fight against muscular dystrophy and its related disorders. Our participating manufacturers have already answered that call. And now we need you.

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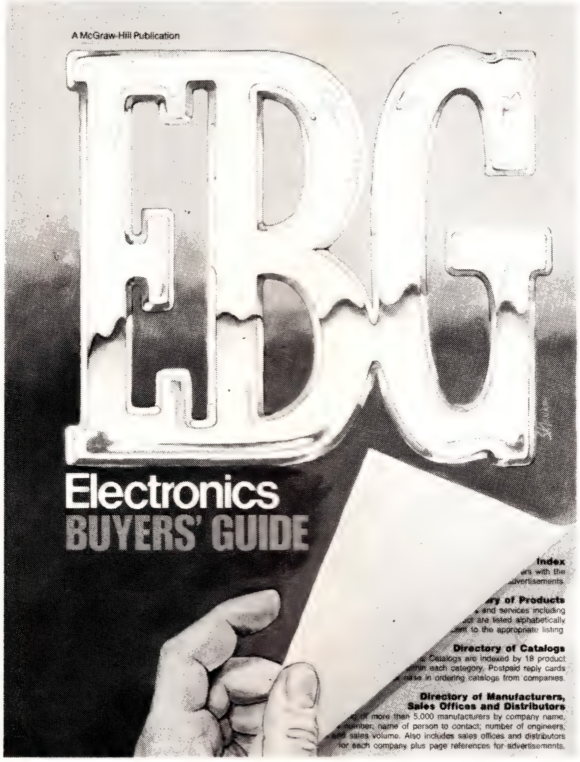
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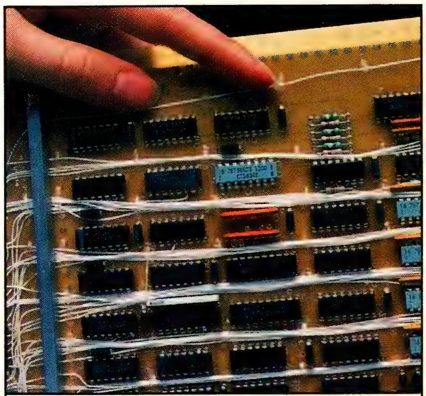
A Texas Control

Months ahead of the market, Control Data is delivering the DDC (Director-to-Device Controller) interface on its 33800 Disk Storage Subsystem. It's an extremely compact, high-speed, large-capacity unit. Most important, it is the only available mass-storage subsystem plug compatible with the new-generation IBM DDC. What helps give Control Data this competitive edge? The SN75174 line driver from Texas Instruments.



Only TI's SN75174 line driver could provide the drive capability vital to Control Data's new 33800 disk storage subsystem featuring DDC interface.

No choice but TI

Only TI's SN75174 could provide sufficient differential current drive through Control Data's special compensation circuit to deliver proper signals in the DDC interface cable.

And Control Data will be able to stay current with future market developments because of the minimum active-high drive (40 mA) capability of the '174.

Forty-two '174s are used in a fully configured 33800 disk storage subsystem.

TI's SN75126 and SN75127 are also used in the new storage subsystem. These circuits meet the IBM 360/370 specifi-

◀ **Leading the market,** Control Data is shipping the first non-IBM storage subsystem that's plug compatible with the IBM Director-to-Device Controller interface. Use of TI's new SN75174 line driver not only made the Control Data design feasible but also minimized design time, component count, board size, and power requirements.

27-4812

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Instruments line driver drives Data to market faster.

cation, providing fault protection and power up/power down protection, as well as enable and fault flags.

Performance as specified

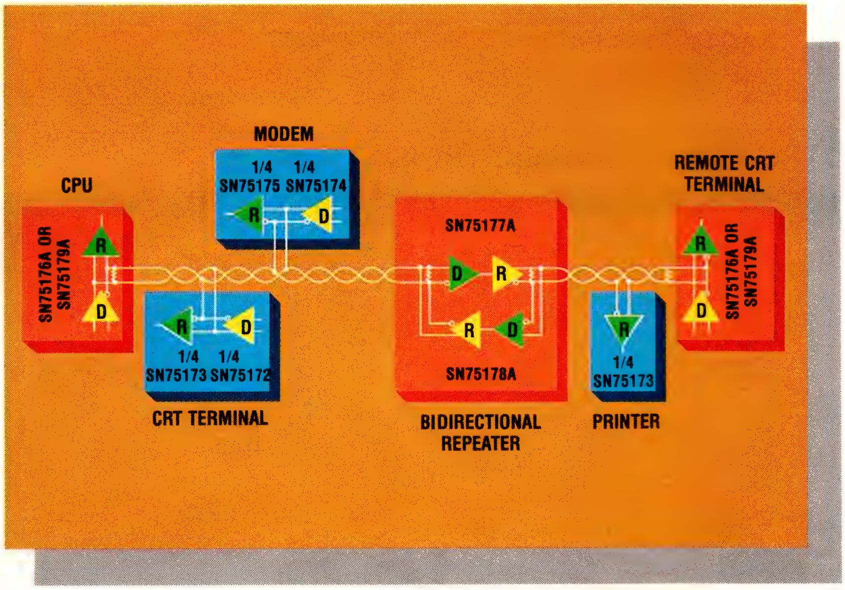
Control Data engineers learned about the '174 early on. Moving quickly, they evaluated and designed it in, counting on it to perform to very exacting specifications. It did . . . perfectly.

The alternative? Greater costs

Control Data engineers estimate that a discrete-component alternative would have resulted in at least a 15% increase in board area to accommodate the necessary additional components.

As it turned out, the SN75174 driver contributed important system savings to the design, improved reliability, helped Control Data get to market faster. ■

Get on the party line faster with eight new line circuits from Texas Instruments.



Hooking 32 driver-receiver pairs on a single bus to achieve party-line communication is possible with TI's full family of line circuits.

Now, eight new line drivers, receivers, and transceivers from Texas Instruments allow you to implement party-line applications on a single bus efficiently.

SN75176A
Half-duplex Transceiver

This new circuit wraps the capability to send or receive data over a single twisted pair in a compact, 8-pin package. It saves board space and cuts component cost.

SN75179A
Full-duplex Transceiver

Also available in a space-saving, 8-pin package, the SN75179A can send and receive data simultaneously, and requires two twisted pairs.

SN75177A/SN75178A
Bus Repeaters

These two differential ICs are identical except for complementary enable inputs. The SN75177A is active high and the SN75178A is active low. This allows you to pair the two back-to-back for improved bidirectional communication when extending cable distance.

SN75172/SN75174
Quad Drivers,
SN75173/SN75175
Quad Receivers

The two quad drivers operate from a single +5 V supply, yet maintain a high-impedance output over a common-mode range from −7 V to +12 V with power on or off. Without sacrificing speed. Both drivers have maximum delay times of 50 ns, rise and fall times of less than 80 ns. They allow data rates up to four megabaud.

The major difference between the two drivers is the enable scheme. And this increases design flexibility. All four drivers in the SN75172 are enabled at once, whereas they are enabled in pairs in the SN75174.

The two quad receivers are similar to existing RS-422 devices but have higher input impedance and extended common-mode range, from ±7 V to ± 12 V. Sensitivity is ±200 mV over −12 V to +12 V common-mode range.

All other standards covered, too

In addition to offering these new devices that meet RS-422 and other party-line applications, TI offers the industry-standard ICs you need to meet the EIA RS-485, RS-232-C, and RS-423 standards, as well as IEEE 488.

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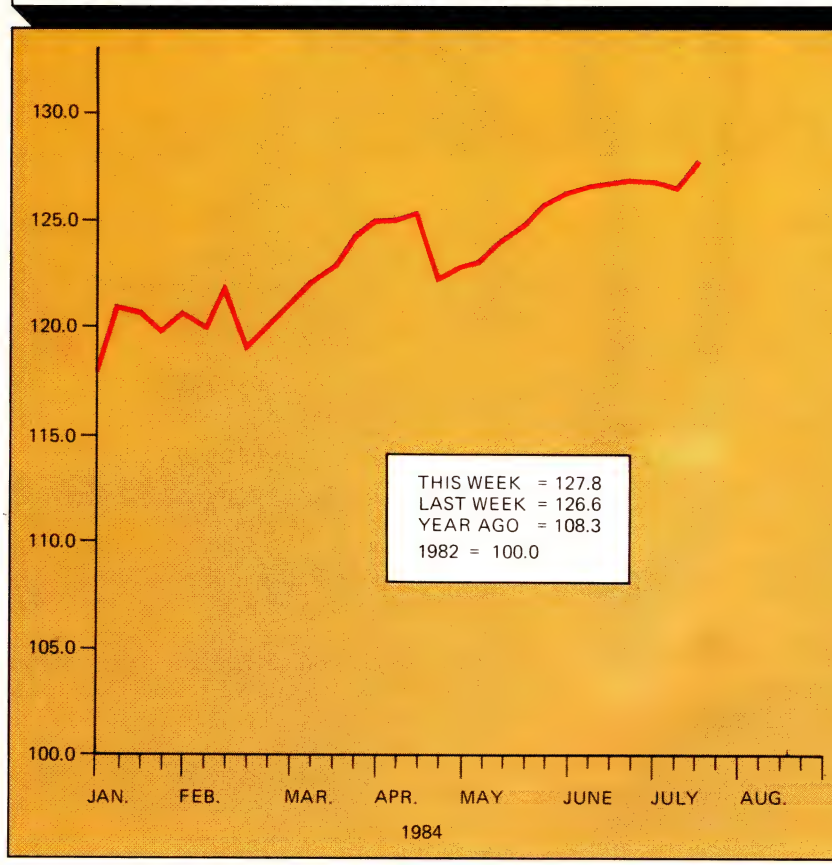
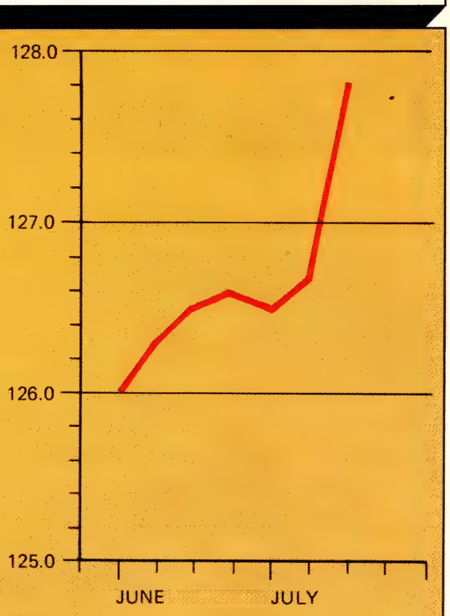




The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear in the Index from week to week.

U.S. ELECTRONICS ECONOMIC INDICATORS

Production workers (thousands)	May 1984	April 1984	May 1983
Office and computing machines	200.2	199.8	187.1
Communications equipment	279.7	277.1	259.4
Radio and TV receiving equipment	63.4	61.8	58.7
Components	414.7	408.0	321.0
Shipments ($ billions)	May 1984	April 1984	May 1983
Communications equipment	4.396	4.286	3.854
Radio and TV receiving equipment	0.930	0.815	0.713
Electronic and electrical instruments	4.857	4.734	3.984
Components	3.707	3.676	2.863

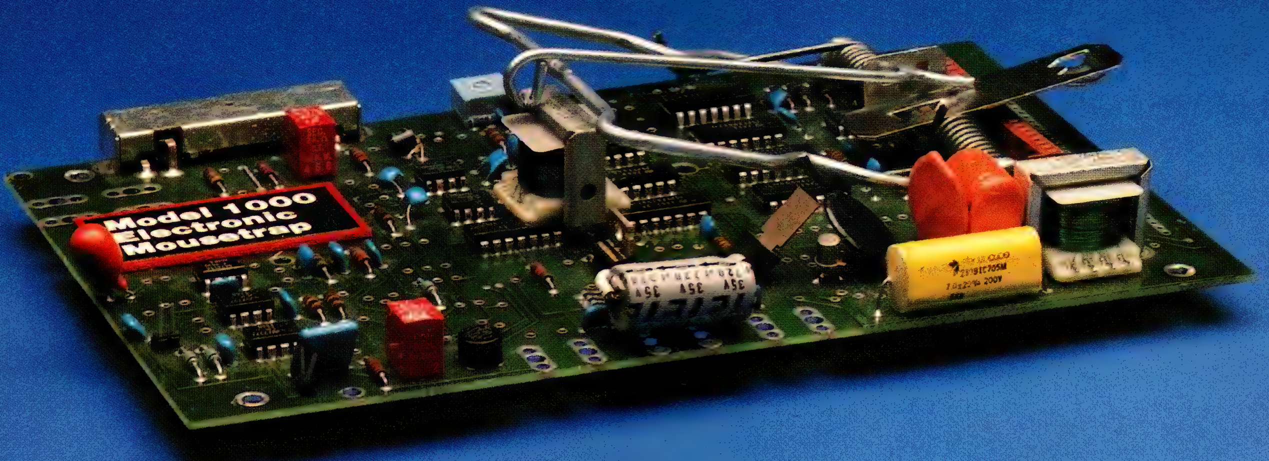
A sharp rise was posted in the *ElectronicsWeek* Index for the latest reporting week. The Index is now 18% higher than at this time last year. Shipments of various electronic products increased 2.8% in May, the latest reporting period, while production employment was up 1.2%. Most of this year's strength continued in components, with shipments advancing 29.5% and employment gaining 24.6%.

More good news came from the U.S. Treasury Department, which reported that government outlays for defense rose 6.6% in May. The only negative news came from car makers, who reported that auto production fell sharply during the first week in July, as some plants started to retool for 1985 models.

Looking to the longer term, there remains a great deal of debate on the crucial issue of what direction interest rates will take. Some economists are pointing to the U.S. economy's low inflation rate and decline in commodity prices as an indication of lower rates. Others see strong gains in housing starts and consumer borrowing as a sign of higher rates ahead.

“If you make a better mousetrap, the world will make a beaten path to your door.”

Ralph Waldo Emerson, 1855



“If you design a better mousetrap, the world won’t necessarily make a beaten path to your door.”

ElectronicsWeek, 1984

In the electronic Eighties industry needs better decisions, not just better designs.

Electronics, the world's most dynamic industry, is changing. And Electronics, the magazine that covers the industry, has been changing right along with it.

Ralph Waldo Emerson was wrong.

Better designs are no longer the only keys to success. In the electronic Eighties a company must make better decisions. And they can only be made consistently by industry professionals who are well informed.

Today, good technical and business decisions must be based on a broad understanding of where the industry is. And where it's going.

In other words, with the kind of insight that only a classic industry publication like Electronics provides.

More disasters to come?

The bankruptcy of Osborne, and RCA's $580-million videodisc write-off are just the tip of the iceberg. More possible disasters lie hidden in the future.

And they can only be prevented by decision makers who, regardless of discipline, possess the most complete, accurate and current industry information available.

This is the
last issue of
Electronics.

JULY 12, 1984
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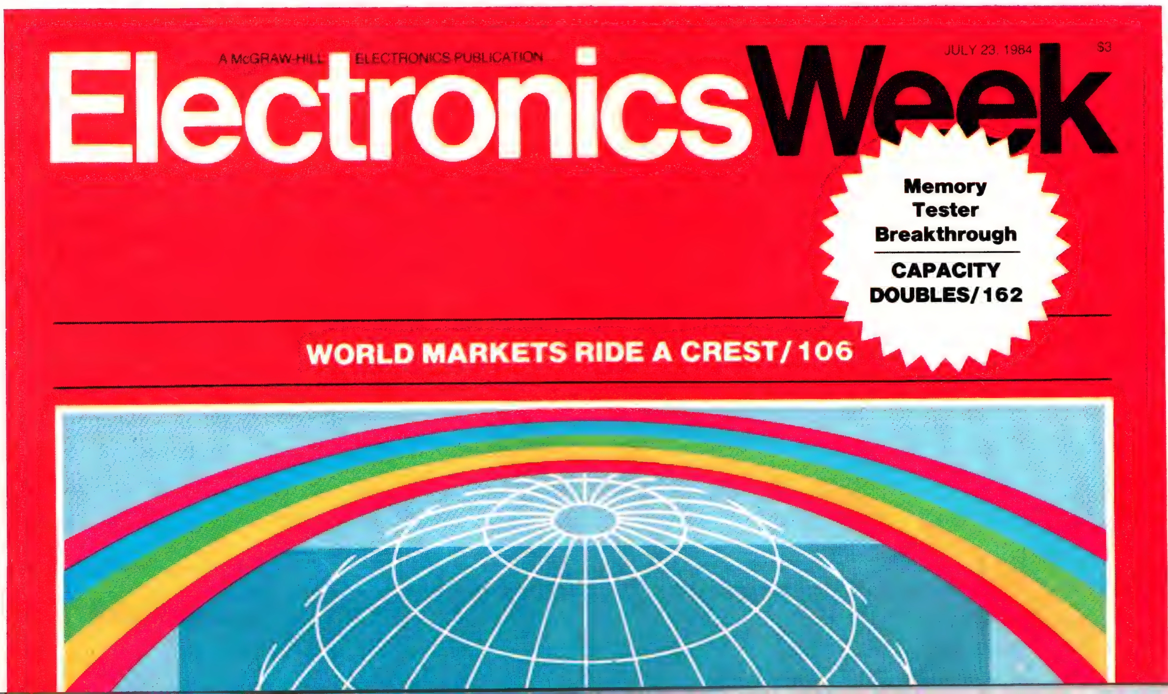
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Washington Insight

DOD'S NEW SUPPORT FOR SOFTWARE SCHOLARS

The academics are back and the Pentagon's got 'em. Schools for software have been panting after the military's proposed Software Engineering Institute ever since the idea's disclosure nearly two years ago. Planned for an operating budget estimated at $50 million annually plus a staff of 250, the institute has universities from Massachusetts to Texas hot to bring it to their neighborhoods. With site selection expected to be made before election day, the lobbying is fierce.

How well will the institute do in resolving the Defense Department's software performance problems, as well as controlling software costs? No one really knows yet, of course, and some sources in industry don't really care. Their interest lies instead in getting it to do for software what the military's Very High Speed Integrated Circuits program did for hardware when it started in 1978—bankroll a crucial area of electronic technology at the same time that new weapons applications are being developed.

The push behind the Software Engineering Institute mainly comes from the fear that the U.S. is already three to five years behind Japan in developing software for factory automation. General Electric Co.'s Donald McNamara, who tracks software productivity, attributes some of Japan's success to its intelligence-gathering effort in the U.S. He estimates that Japan has some 1,500 software engineers collecting information by attending shows, seminars, and researching available literature. About how many Americans are doing the same thing in Japan? "About five," he responds.

Automation of production is much on the minds of both U.S. and Japanese companies, while the Pentagon and others in government see it as a cure-all for escalating weapons costs. Japan's interest in perfecting its software expertise comes from more than plant automation, however. The Japanese also badly need better software to succeed in the world's developing market for personal computers.

The current passion for those machines in the U.S. overshadows the fact that the market is still small and the technology relatively primitive, many observers point out. When a consumer can acquire a sophisticated product at a price equivalent to that of any other major appliance and use it immediately, getting his or her instructions from the system itself, then the day of the personal computer will truly have arrived.

With that in mind, Japan is pushing toward such a time with characteristic persistence, although by a different route from the U.S. and its software institute advocates. As has been done in some weapons systems, Japan is striving to use embedded integrated circuits as its key to success in personal computers. A successful effort will do more than bring down the cost of personal computer hardware; it will also dramatically reduce the cost of useful software from hundreds of dollars per program to tens, resulting in a major new market.

Before this heavenly vision materializes, however, the computer industry—especially the sector devoted to personal computers—can expect to go through a severe shakeout. The dimensions and impact of this upheaval will be marked by the disappearance of producers of hardware and software, as well as by the superabundant supply of such peripheral materials as books, magazines, and newsletters.

Whether the Software Engineering Institute, wherever the Pentagon ultimately decides to locate it, is among the survivors will be the ultimate test of its contribution to the global competition.

–Ray Connolly

BODT PLANS TO KEEP ELCOMA ON TOP OF THE NEXT RECESSION

Eindhoven, the Netherlands

Getting products out the door is right now the principal concern of top managers at major components suppliers around the world. But Henk Bodt, the 46-year-old Dutchman who heads the commercial side of the $3 billion Electronic Components and Materials Division of Philips International BV, also has an eye cocked toward the difficult days that inevitably lie ahead.

"We all know there'll be a recession; the question is when—and how deep," says Bodt, who at the beginning of the year was named senior managing director of Elcoma—based, like its parent, at Eindhoven, the Netherlands. The ultimate answer to the question, he feels, depends on consumers.

Although consumers' discretionary spending power has been reduced in recent years, they have continued to buy such electronics-laden equipment as automobiles and telephones, as well as entertainment electronics. Even markets that are flat in numbers of units sold continue to generate some growth for chip makers such as Elcoma, as more and more integrated circuits go into consumer hardware of all sorts. "We now have one-chip radios and two-chip TVs," Bodt points out.

Bodt, who earned a degree in electronics engineering from the Eindhoven Technical University, started his career as a researcher in Philips' basic-research laboratories. Since he moved to Elcoma from a corporate planning position, he has strived to link an automated order-handling system more closely to the production lines. "Readjusting production schedules on a monthly basis—as we used to—is just too slow," he says.

He is also pushing for "just-in-time" delivery. Elcoma makes 90% of its deliveries (from a catalog of 60,000 active parts) within a target window of one week. But he wants to do better: "Signetics [Philips' California-based semiconductor-producing subsidiary] scores 95% on promised-day deliveries," he explains. For that sort of performance, says Bodt, conventional wafer-to-package runs are not the answer. "You have to set up stock points with finished wafers ready to package. The packaging can result in four or five versions of each chip."

Lean machine. Automated order-handling systems and just-in-time delivery are ways Henk Bodt will streamline operations.

When the downturn does come, technology will alleviate the difficulties, Bodt is convinced. Because of process improvements such as the current shift from 4- to 6-in. wafers, he says, efficiency increases naturally from 8% to 10% a year.

If growth doesn't surpass that increase, capacity has to be compressed, he explains. The last recession forced European companies to make such cutbacks, and they have lost market share on their home ground—which accounts for 25% of the world's components sales—now that business conditions have improved. The European market always depends on what goes on elsewhere, he observes. –**Arthur Erikson**

Moriyama leads first Japanese effort to set up a private common carrier

Tokyo

Shingo Moriyama, an executive vice president at Japan's Kyocera Corp., which makes almost 60% of the world's ceramic packages for semiconductors, calls himself a happy man these days. He says that's because he relishes the chance to promote the public interest by providing his country with better telecommunications.

Besides his Kyocera post, Moriyama is also president of newly formed Daini-Denden Inc. That 25-company consortium has become the first group to announce its intention of competing with Nippon Telegraph & Telephone Public Corp. as a common carrier, beginning next April, when NTT will lose its telecommunications monopoly.

Led by Kyocera, which has a 35% share, Daini-Denden will start by constructing voice, data, and image links along the Tokyo-Osaka-Kobe corridor, where most of Japan's population and commercial interests are concentrated. "We will offer our first services in 1988," he says.

A new career. Moriyama, 58, brings organizational rather than technical skills to his new job. After graduating in law from Kyoto University, he spent 33 years at the Ministry of International Trade and Industry, retiring as director general of the Natural Resources and Energy Agency. At the urging of president Kazuo Inamori, an old friend, he joined Kyocera last year.

Currently, Moriyama is busy trying to expand the staff at Daini-Denden, which has only about 20 employees. In a year, he expects to have about 1,000 people aboard. He is also supervising the company's research into the precise combination of cable, fiber optics, microwave, satellites, and other gear that will make up its network.

At least three other important groups are expected to enter the common-carrier sweepstakes soon, and Moriyama predicts that competition will be fierce. The costs are so high that he expects some groups to merge. "It will take at least about $42 billion to build even a modest network, and there's no proof it will be profitable," he says. –**Peter Hahn**

Papa Bell-san. A private firm led by Shingo Moriyama means to give the Tokyo-Osaka-Kobe corridor voice, data, and image links.

Morton seeks to pull together HP's efforts so firm can offer one-stop shopping

Palo Alto, Calif.

No other company is positioned to deliver such a broad range of computational solutions," says Dean O. Morton, referring to Hewlett-Packard Co., which he now runs as chief operating officer. HP's line of instruments, computers, and work stations was so broad, in fact, that the company decided, after months of internal discussion, to reshuffle its operations in order to maintain its image as a single company with a one-stop shopping solution for its customers.

The shuffle [*ElectronicsWeek,* July 23, 1984, p. 38] pushed Morton, 52, close to the top of the deck as COO, a new position for HP, in which he will be responsible for day-to-day operations and will report directly to president and chief executive officer John Young. "We've become a highly visible company, and John will be devoting more of his time to outside activities. He expects me to be heavily involved in internal affairs," Morton says. "I think we will function as a team."

Young has long been considered heir apparent to HP chairman and founder David Packard, 71, but HP has publicly denied that Packard has any immediate plans to step aside. Morton also holds outside responsibilities as president of the American Electronics Association [*Electronics,* Jan. 12, 1984, p. 14].

Morton indicates that key to the HP reorganization was the creation of a separate marketing and international sector. "It will be managed at a level that is close to the customer, so that we can configure systems to address customer needs." This sector pulls together worldwide sales for all HP's measurement and computation products, plus major accounts and other corporate-level marketing efforts. It will be directed by Richard C. Aberding, 53, like Morton a former head of the Medical Products group.

Shifting orientation. HP has long been considered a highly competent technical company that sometimes stumbles in the marketplace. Without acknowledging any shortcomings, Morton noted that "we felt it was important to become more market-oriented. Our general strategy is to enter into partnerships with our customers that result in integrated solutions."

He helped direct the HP restructuring as chairman of its management council, the company's policy-making committee. The process began some eight months ago, Morton says, when "John Young began asking some powerful questions" about HP's future. The reorganization still is not complete, Morton says. "We still have a long way to go, and my job is to facilitate the process."

In addition to the marketing sector, HP now has three major sectors (a fourth serves financial and administrative needs):

- Measurement, design, and manufacturing systems, responsible for electronic instruments, microwave and communications products, and computer-aided engineering and manufacturing systems.
- Information systems and networks, including business and personal computers, peripherals, and networks.
- Analytical, components, medical, and technology, with the addition of HP Laboratories and the central research and development facilities as well as corporate manufacturing and engineering sections.

The analytical sector will be headed by Paul C. Ely Jr., who will direct HP's long-range strategies for research and manufacturing.

HP expects a whopping increase in its revenues for this year, from $4.7 billion to nearly $6 billion. Despite such success, "There are times when change is needed," Morton says. "If we throw away the advantages we have as a single company, we've lost an important competitive edge." –**Clifford Barney**

Royal deal. As chief operating officer, Dean O. Morton is responsible for day-to-day operations of the Hewlett-Packard Co.

THOMSON-CSF GUNS FOR TOP-10 IC SPOT

Paris

Long caught in that no man's land of the components business—neither captive nor commercial, neither broad-range nor specialty supplier—Thomson-CSF is in the midst of a reorganization aimed at nothing less than positioning it among the top 10 semiconductor operations in the world.

Symbolic of a new Thomson is its debut in the dynamic-memory business at a time when most observers would say that the entry point had long since passed the company by. The year-old program has already produced results for the Parisian company—which trades under the name of Thomson Semiconducteurs—that are concrete enough to suggest the goal is more than just wishful thinking.

For a start, sales will nearly double this year to between $185 million and $200 million. In addition, the nationalized company will benefit from investments of nearly $1 billion between now and 1990.

But realizing such an objective at Thomson—a company that has never been profitable in semiconductors—will require not only increased sales and investment but a fundamental change in attitude as well.

Wielding the baton. The job of orchestrating the necessary transformation belongs to Jacques Noels, former president of Texas Instruments (France), whose tenure at Thomson began with a series of sweeping changes in his management team. His goal is to reorient the division, which has always had a good reputation for its design quality, into a serious production house.

As Noels describes it, Thomson's former approach to integrated-circuit fabrication was almost a recipe for disaster. "For virtually every circuit we used to put into production, we would institute a new process to the point of even physically isolating each one of them in its own fabrication area," he explains. "But during the past year, we've made an enormous effort to homogenize and streamline our fabrication cycle. I would estimate that we've simplified the complexity of our production processes by a factor of about five."

Thus, at Thomson's EFCIS plant in Grenoble, output of MOS ICs has risen sixfold during the past year. At nearby St. Egreve, where the company carries out its bipolar circuit fabrication, production figures have increased fourfold in that time. These impressive improvements are the substance behind Noels's belief that Thomson "can, and must" enter the dynamic-memory market.

He will give few details, but notes that Thomson already has the technology, "so what we've got to do is find the recipe." He recognizes, nonetheless, that time is of the essence: "The window for getting into the market is the next 12 months."

The imperative stems from his conviction that, for Thomson to get the 3% of the market that will put it among the top 10 makers, the firm must be a broad-range supplier in the fullest sense of the term. "We already have a catalog that's one of the most diverse in the business, and we've got to keep producing more of those products more efficiently," he explains.

"But we can't simply ignore high-volume parts, like dynamic memories, by saying that we've never made them and that for production reasons it's too late to get started now," he continues. "If we concede that market, we'll concede others, and what will we have left? It's very dangerous to shy away from production problems."–**Robert T. Gallagher**

U.S. market is critical to Thomson's strategy

Rutherford, N.J.—For Thomson-CSF to be in the top 10 worldwide suppliers of semiconductors, it must succeed in the world's largest chip market: the U.S. "We rank 21st [in the world] now, and the objective is to make the top 10, which means a strong U.S. presence," notes Jacques Fauque, vice president and general manager of Thomson Semiconductors, Rutherford, N.J.

"We're coming in with our own strategy," says Fauque. In essence, the outfit will manufacture first, then do business. The unit, which bundles Thomson's U.S. semiconductor efforts under one name, will kick off soon with a full-fledged fabrication plant at Montgomeryville, Pa., near Philadelphia. The facility was purchased in 1979 from Solid State Scientific Inc. for production of rf semiconductors, a Thomson specialty in Europe.

However, plans for the major U.S. expansion into most semiconductor types date only from 1982-83, and the company has deliberately made its organizational changes quietly until all was in place, says Fauque. The aim of Thomson's U.S. arm is a near-equal balance among rf products, discrete small-signal and power devices, and integrated circuits. In MOS microprocessors and microcomputers, a second-source program is in place. Thomson already has announced products for Advanced Micro Devices Inc.'s 4-bit 9400 family and Motorola Inc.'s 68000 line, along with the 16-bit 68000 processor. In the works are bipolar gate arrays and additional MOS families. Coming are some 3,000 chips to be made in the U.S.

Neither U. S. nor French officials will divulge specific results or targets for now, but Fauque says budgets call for a near doubling in sales this year and a tenfold increase over 1983 within five years. A complete sales organization has been set up, based in the Canoga Park area of Los Angeles. –**Larry Waller**

Maverick EDS's task is to retain spirit, spunk under new owner, GM

Dallas

Inside the main lobby of Electronic Data Systems Corp. in this city stands a bust of John Paul Jones, a naval hero of the U.S. Revolutionary War. Below is a plaque bearing the commander's immortal words: "I have not yet begun to fight." The work is intended to symbolize the growth and determined spirit of the computer services and systems integration firm.

But last month's $2.5 billion pact under which EDS will become part of General Motors Corp. has many industry observers wondering if the computer services company can maintain its feisty corporate style and its approach to unfavorable odds in the marketplace. "Historically, the thing that has turned on EDS employees is the competition against big firms, and in the past, EDS has often been the clear underdog," says Ralph Shive, industry analyst at Rauscher Pierce Refsnes Inc. in Dallas.

Much of the legacy surrounding EDS derives from the $1,000 and idea that H. Ross Perot used to start the firm in June 1962. A salesman for International Business Machines Corp. in the early 1960s, Perot noticed that expensive computers were not in use around the clock. Moreover, in the 1960s many companies could not afford mainframes. In his new venture, Perot began renting computers when they were not in use. Material was picked up from his clients, processed, and later returned by messenger service. Eventually, of course, he bought his own mainframes.

Early starter. "He [Perot] is really one of the old-timers in the business and a founder in the computer service industry," notes Richard Sherlund, an analyst who tracks software and computer service firms at Goldman, Sachs & Co., New York. When other companies began offering raw mainframe power to clients through timesharing services, EDS "took a different approach, concentrating instead on facilities management, data processing programs for specific markets, and, eventually, total systems integration," adds Sherlund.

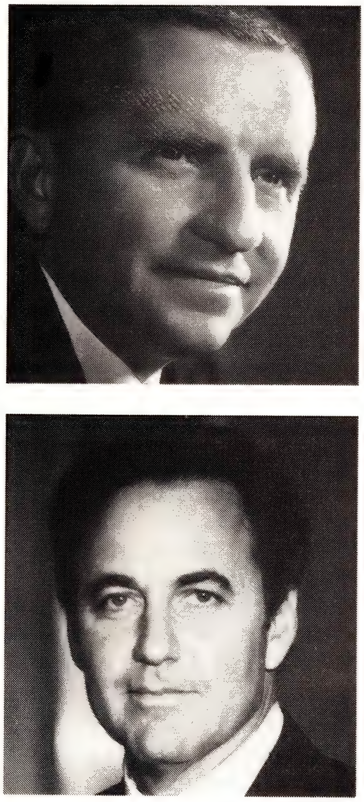
Through the 1970s, EDS built its reputation in such regulated industries as insurance and banking. In 1979, it marched into Washington, D.C., and won big systems integration contracts from the Army and Navy against established leaders in the military market. With the GM pact—and the billions of dollars GM spends annually on data processing and systems integration—EDS is driving deeper into large corporate markets, analysts agree.

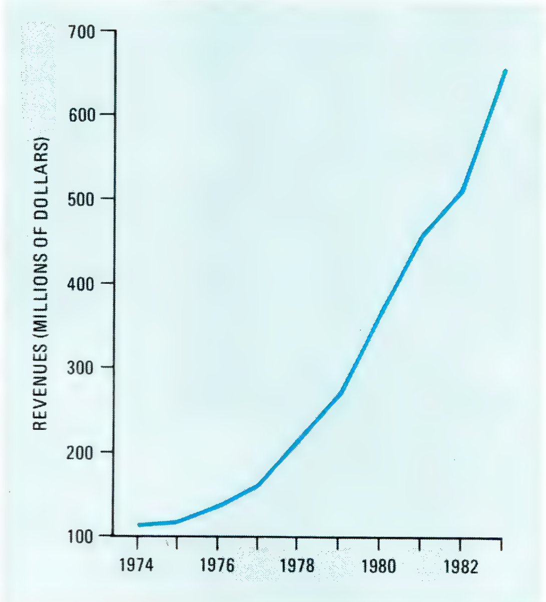
The purchase agreement is the largest in the history of the computer services industry, according to George Grodahl, a partner in Broadview Associates, a Fort Lee, N.J., merger and acquisition consultant. Grodahl believes the deal represents a "long-term trend which has made [computer services] one of the most acquisition-prone industries for the last 10 years."

Once the agreement is approved, EDS is expected to pick up all of GM's data processing business and to take on the chief role in developing future computer networks for the auto giant. GM chairman Roger B. Smith anticipates EDS will play a key role in his firm's industrial automation attempts. EDS will market manufacturing and other systems developed by GM.

In its 1983 fiscal year, EDS had revenues of $651.6 million, with a net income of $58.7 million. GM's internal business is expected to be more than sufficient to make EDS the largest computer services firm in the world, passing the current market leader, Automatic Data Processing Inc. of Clifton, N.J.

GM is planning to merge its own data processing personnel into the EDS operation, which will continue to be an independently run subsidiary and remain under the control of its current management in Dallas. Moreover, Perot has been given a seat on GM's board. But many believe the trick will be preserving the EDS corporate culture, much of which hinges on Perot and EDS president Morton H. Meyerson, to whom Perot has been delegating more power in recent years. **–J. Robert Lineback**





Surging. EDS revenues have soared in the past 10 years, and analysts expect a 20% increase in 1984.

At the helm. EDS founder and chairman H. Ross Perot (top) and president Morton H. Myerson must chart their firm's course through GM's corporate waters.

SPECIAL REPORTS

PC BOARDS GO HI-TECH TO MEET NEW DEMANDS

Lasers, new resists and substrates, and automation help printed-circuit boards accommodate needs of VLSI and surface mounting ☐ *by Jerry Lyman, Packaging & Production Editor*

Under pressure to accommodate the dual demands of very large-scale integrated circuits with high lead counts on tightly spaced centers and surface-mounted devices that both demand fine lines and tiny vias, the giant printed-circuit-board industry is starting to move away from its conservative approach and into a number of new areas. Among them are:

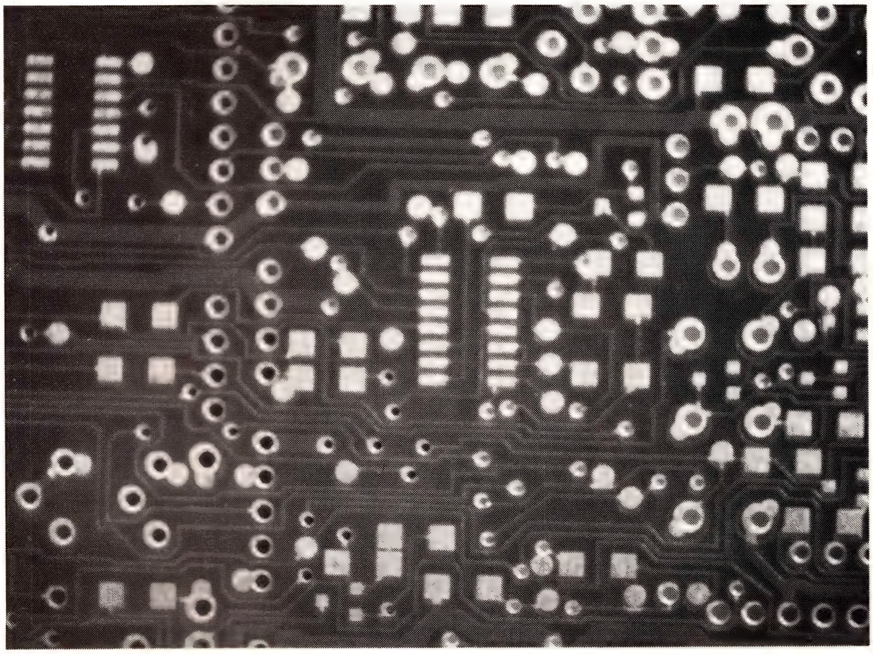
- Laser exposure of either pc-artwork or resist-coated boards.
- New permanent resists to protect fragile fine lines.
- A dry thermomagnetic resist process.
- Complete automation of the pc-board process.
- Composite and exotic substrates for leadless ceramic chip-carriers.
- Thermoplastic as either an extruded or a molded pc substrate material.

A number of important trends showing up in today's pc-board industry indicate where these developments will have the greatest impact. Noticeable changes include a surprising increase in the independent pc-board fabricators' share of the market as well as a possible renaissance of the fully additive plating process.

As the 1984 World Market Forecast showed [*Electronics*, January 26, 1984, p. 8], the independent pc-board market in the U.S. is about $2 billion and growing. The fastest-growing segment is multilayer boards with a 35% growth predicted for 1984.

One very interesting trend is a perceptible growth of the market share of the independent pc-board producers. According to data released by the Institute for Interconnecting and Packaging Electronic Circuits, the independent portion of the market grew from 54% to 59% in the last year, whereas the in-house market share decreased from 46% to 41%. One reason for this increase may be the independents' increasing ability to turn out fine-line circuits—an ability that only the high-technology in-house facilities had before. For example, marketing specialists at E. I. du Pont de Nemours & Co., one of the largest suppliers of dry-film photoresists to the pc-board industry, note that many of the firm's customers are routinely doing 6-mil lines and spaces in production. Five years ago, independent producers could only fabricate boards with 10-mil lines and spaces. Now, a few independents are even doing 4-mil lines and spaces.

With the advent of surface mounting [*Electronics*, February 9, 1984, p. 113], which requires mixing standard dual in-line packages, SOICs (small-outline inte-



1. Surface-mounted. Surface mounting creates densely packed boards. This one from Kollmorgen's Additive Products Division handles passive chips, small-outline integrated circuits, hybrids, quad flat packs, leaded chip-carriers, and dual in-line packages.

grated-circuit packages), leaded chip-carriers, quad plastic flat packs, and even thick-film hybrids (Fig. 1), the pc-board industry must go to finer lines and smaller holes, or vias, to survive.

In the U. S., epoxy-glass laminates still dominate the pc-board field. Japan, on the other hand, goes heavily toward the use of paper laminates—a lower-cost material that can be punched, which eliminates a drilling operation. Also, paper laminates are well-suited to the fully additive plating process.

As far as plating is concerned, the U. S. capacity is mainly subtractive, with some additive capacity and a little semi-additive processing. Japan, however, has the largest fully additive capacity in the world, and it is growing. In Europe, though semi-additive processing is larger than anywhere else, subtractive processing still dominates.

Additive growth

The Japanese were quick to realize the advantages of additive processing, such as a fine-line capability and an ability to plate very fine holes, to produce a planar board surface for surface mounting, and, of course, to be plated on almost any substrate, including paper. In view of these advantages, it may seem surprising that fully additive processing has not taken hold in the U. S.

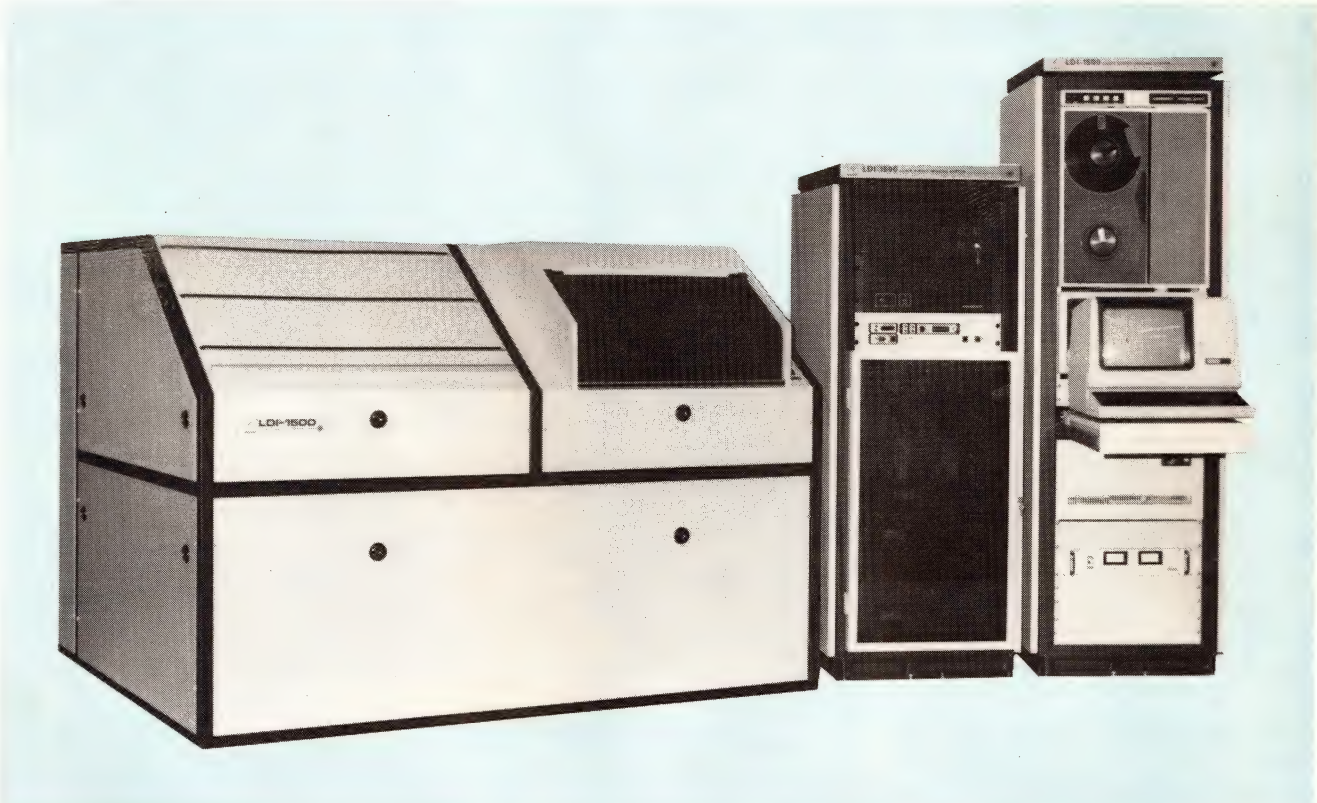
According to Lenny Smookler, technical marketing manager of the Kollmorgen Corp.'s Additive Products Division, Aquebogue, N. Y.—the largest independent producer of fully additive boards in the U. S.—there are several reasons for this situation. The first was that the vast majority of pc-board firms were based on subtractive processing and weren't willing to change to a process requiring a large capital investment. In addition, subtractive processing could produce the relatively wide-line boards of 5 to 10 years ago.

A second reason was the tendency of the electroless copper used in the plating process to crack under severe thermal shock. This factor caused producers of military-type pc boards to shun the fully additive process. But Kollmorgen's PCK Technology Division, Melville, N.Y., has now developed a crack-free additive process that eliminates this problem.

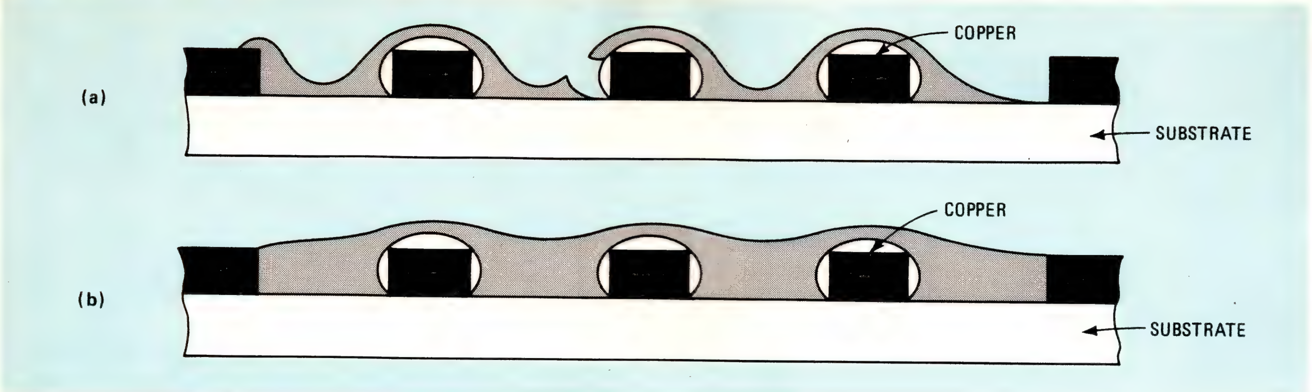
With this improvement and the process's inherent fine-line capability, additive processing will not only be able to take on complex high-density surface-mounted boards but also allow the cost-cutting application of paper substrates. In view of this, it is conceivable that the use of fully additive processing could soon spread to other independents in the U. S. (The technique is already in use at some very large in-house facilities, such as IBM and Western Electric.)

No matter what process is used to produce pc boards, an important limiting factor is the quality of the artwork and the characteristics of the optical exposure equipment. And as line widths get down to several mils and below, these limitations get worse. This is why laser-exposure systems for pc lithography should take on an added role in the future.

Laser-exposure systems for generating artwork on photosensitive films or exposing a circuit pattern onto a resist-covered pc substrate are almost analogous to the scanning-electron-beam lithography systems currently in heavy use in processing masks and in directly writing on



2. Going direct. The Gerber Scientific direct-imaging system uses an argon laser to directly expose computer-generated circuitry patterns onto a resist-covered printed-circuit board. It can plot 3-mil lines and spaces onto a photosensitive dry-film resist.



3. Covering up. High-density printed-circuit boards with closely spaced conductors can't be covered adequately with a screened-on resist, resulting in voids and skips (a). A Vacrel dry-film resist conforms to the board's contour and totally encapsulates the conductors (b).

resist-covered wafers for ICs. In a typical laser-exposure system, an argon laser under computer control scans a finely focused spot across a photosensitive film or resist-covered panel moving at a constant velocity.

Like the electron-beam lithography system, the laser system's main advantages are high resolution and speed. The laser lithography systems can easily expose minimum feature sizes of from 0.5 to 3 mils, depending on the machine type, in both artwork-generation and direct-imaging modes. In artwork generation, usually done on silver halide or diazo film, artwork that took hours on a mechanical plotter are compressed to minutes, while direct-imaging times are also measured in minutes.

Both direct imaging and artwork generation are suitable for complete automation in a computer-aided design and manufacturing linkup. Direct imaging, however, eliminates the need for a phototool (mask). In addition, the laser-exposure system is ideal for quick engineering changes in metamorphosis artwork or, in the case of direct imaging, for making changes in pc wiring. Finally, a direct-imaging system opens up the possibility of doing a system's complement of prototype boards in only one pass, as opposed to the usual process of letting each board type queue up in the design-fabrication pipeline. Taking this approach could radically cut system debugging time.

Two laser setups

Two types of laser systems, with either flatbed or drum drives, are on the market. The flatbed system (Fig. 2), the first to appear commercially [*Electronics*, October 23, 1980, p. 224), can be used as either an artwork generator or as a direct-exposure machine. The drum type, which first appeared this year, is solely for artwork generation.

Both Gerber Scientific Co., Tustin, Calif., (formerly Eocom Inc.) and Excellon Automation, Torrance, Calif., produce flatbed machines. Gerber has the largest customer base with about 25 machines in the field, of which about half are direct-exposure types. These machines can typically image an 18-by-24-in. panel.

At least two companies introduced scanned drum systems for artwork generation in 1984: Macdonald Dettwiler and Associates Ltd., Richmond, B. C., Canada; and Optronics International Inc., Chelmsford, Mass. MDA's Fire 9000 has a maximum plot size of 24 by 36 in. with a maximum resolution of 0.25 mil. Optronics' 2420 laser photoplotter can accommodate a film up to 20 by 24 in. with a maximum resolution of 0.5 mil. The MDA system can plot a 24-by-36-in. pattern with 1-mil resolution in about 2½ min, while the Optronics unit plots an 18-by-22-in. pattern with the same resolution in less than 15 min. As for cost, laser exposure systems range from $300,000 to $400,000—except for the Optronics system, which costs about $130,000.

While the spotlight was on the laser photoplotters, the critical field of photoresists for pc-board work has made some important advances, one of which could have a great effect on laser exposure time. Meanwhile, two other resist developments are already having an effect in fine-line fabrication, and a dry thermomagnetic-resist printing process shows promise.

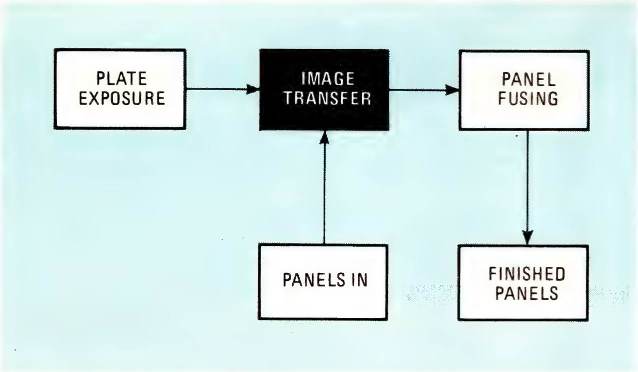
Resistively speaking

Today, according to experts at Du Pont's Riston Products Division, most direct imaging is done with dry-film resists designed for full wide ultraviolet exposure of an entire board . These resists have a sensitivity of about 100 mJ/cm^2 and faster films usually have a limited shelf life. Du Pont, however, now has two experimental resists designed for direct laser exposure. These aqueous dry-film resists have a sensitivity of 10 mJ/cm^2 and an extended shelf life. One of these new films, however, responds to laser radiation in the visual rather than the ultraviolet spectrum, which allows more efficient use of a laser's output.

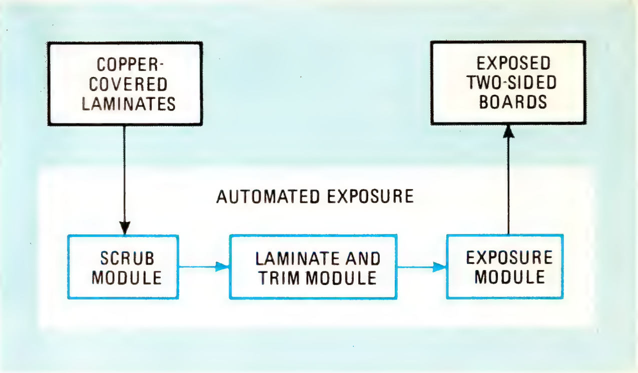
Using today's direct-exposure systems and a conventional resist, a 21-by-24 in. pc-board panel could be exposed in 2 min. With the same panel, the experimental resist, and a laser with a 17.5-W output in the visual spectrum (488 nm), exposure time could be reduced to 6 s. If the laser power is reduced four times, exposure time rises to 30 s, still respectable, but tube life is extended.

With exposure times in the 6-to-30-s range, direct exposure could be attractive as a production, rather than as a prototyping, method. But only time will tell whether, as in electron-beam lithography, the main use of laser systems will be to generate artwork rather than direct exposure of patterns on boards.

Fine lines (8 mils and below) are fragile. They may be scratched in handling, bridged during soldering, or even contaminated chemically. Thus they must be protected in



4. Magnetic-resist exposure. In the Cirtrack system, a premagnetized plate is contact registered with printed-circuit artwork and exposed to a scanning Xenon flash. Using a special magnetic toner, the plate's image is transferred to a copper-covered panel.



5. Automated exposure. Du Pont's automated, integrated printed-circuit image-transfer system requires only two operators. Panels are automatically cleaned, aligned, spaced, laminated, trimmed, registered, and exposed on one self-contained unit.

both additive and subtractive pc-board processing. New dry-film resists solve this problem.

For example, Kollmorgen's Additive Products Division is using an advanced permanent photoresist developed by Du Pont to manufacture and protect its fine-line additively processed boards. This material remains between all critical circuit features, preventing solder bridges between closely spaced conductors and lands. The resulting planarized surface provides a superior vehicle for placement of surface-mounted components and skip-free solder masking. Using this technique, the firm can routinely run two conductors between 100-mil centers, and it is expected to support the running of three conductors between 100-mil centers fairly soon.

For the pc-board industry's mostly subtractive portion, Du Pont and Dynachem have developed dry-film solder masks to protect fine lines. Du Pont's material, Vacrel, is vacuum-laminated to a finished, subtractively processed pc board, removing all air between the mask and circuit board and ensuring intimate contact and optimum adhesion. This solder mask conforms to the board's contours and totally encapsulates the conductors, all but eliminating solder bridging. A comparison of a screen-printed and dry film mask shows the deficiencies of the screen-printed resist (Fig. 3). Since Vacrel is a dry-film photoresist, it is suited for fine-line circuit protection.

A magnetic resist

Not all pc-board resists are photosensitive polymers. Du Pont has perfected a magnetic dry-toner resist composed of a thermoplastic resin-extended magnetizable iron-oxide pigment that it worked on for five years. This material is an important component of the company's Cirtrak process, a system for thermomagnetic-resist printing of pc boards (Fig. 4).

The Cirtrak process starts with the premagnetization of a printing plate coated with chromium dioxide. Then the image of a phototool is transferred to the plate. This is done by selective demagnetization of the printing plate through the thermal energy of a Xenon flash in the phototool's clear areas, which puts a latent image of retained magnetization corresponding to the phototool's opaque areas on the plate. The plate is then passed through the toner, whose resist particles cling to the latent magnetic image on the plate. At this point in the process, any excess toner on the plate is vacuumed off.

Under the appropriate temperature and pressure, the toner is then transferred to a preheated copper laminate and fused into a more stable resist image. The copper under the resist, protected from being dissolved by an etchant, will then form the pc-board's circuit pattern.

In the image transfer process (Fig. 5), the plate moves through an imager module into the Cirtrak printer and passes through a fluid bed of magnetic dry toner. The plate's magnetic image is then transferred to the panel by the print drum, selectively covered with toner. Finally, resist-coated panels are fused and hardened in the oven attached to the printer module.

Flexible system

The Cirtrak system, which is currently in beta testing at two sites, processes 250 to 300 images per hour and routinely produces circuit details of 10-mil lines and spaces on 18-by-24-in. panels. Du Pont's system engineers are upgrading system performance to 600 images per hour and 6-mil lines and spaces.

In addition to being applied to copper-covered epoxy-glass, composite, and paper rigid boards, the system can print on either the inner layers (prepreg) for multilayer boards and on flexible-circuit substrates. In the latter case, the system could be set up for a roll-to-roll application, where the system's 30-linear-ft/min rate would make for a high throughput of the flexible substrates.

Automated pc-board lines in the U. S. are mainly confined to the electronic giants in the computer and telecommunication fields. But for independents to compete with overseas competition and also raise the yield of fine-line pc boards will require these companies to automate their production lines. Unfortunately, until this year only individual processing modules—such as dry-film laminators, exposure units, ovens, and cleaners—were available.

In February 1984 at Nepcon West, in Anaheim, Calif., Du Pont, usually regarded as a materials-oriented company rather than a manufacturer of automated equipment, introduced a fully automated image system for high-density pc boards, thus automating a critical portion of the line. In effect, the in-line I-System accepts inputs of copper-covered panels and dry-film resists and puts out two-sided pc boards with exposed dry-film photore-

6.. Transparent boards. Semi-additively plating a clear extruded polysulfone board produced this transparent two-sided printed-circuit board used for housing back-lit graphics and membrane switches. The board is part of the climate control panel of a 1984 car.

sists on both sides. Operating at a rate of 150 panels per hour, the system needs only two operators to process boards from panel loading through development, including cleaning, lamination, removal of the dry-film base sheet, artwork registration, and exposure. A nonintegrated version would require up to seven.

Compared with conventional circuit-imaging techniques, yields of fine-line circuits processed through the I-System are significantly greater, approaching 95%. This increase comes from the lack of a cover sheet on the special film photoresist used, controlled cleanliness of the copper surface, and superior film adhesion from the unique two-layered photoresist made without a polyethylene separator sheet. In addition, with the special resist the I-System can turn out boards with 4-mil lines and spaces in a production mode.

In operation, the I-System (Fig. 5) places a stack of as many as 150 copper laminates on its loading platform. A feeder continuously passes the panels into a cleaning chamber, where they are sprayed with water, scrubbed, and dried. In an adjacent chamber, the panels are next laminated on both sides with the special dry-film photoresist and trimmed.

The system then conveys the panels into an exposure chamber, where artwork is pin-registered to both sides and exposure is timed precisely. This artwork is repositioned automatically, and the imaged panel transported on a conveyor belt to a developer. Du Pont has the I-System under test at five field sites and plans to increase system throughput to 240 panels an hour.

In his paper "Nonconventional Substrates," given at the Printed Circuit World Convention in Washington, D. C., in May 1984, George Messner, senior scientist at PCK Technology, noted that for over 20 years the electronics industry has used the same familiar materials for mounting and interconnecting electronic components. The substrates used for hybrids were chiefly ceramics; for pc boards, they were copper-clad laminate sheets that mainly employed one of three thermoset resin systems: phenolics, epoxies, and polyimides reinforced with paper or woven fiberglass.

But these substrates fell short in some areas. Surface mounting, attempts to match the board to the thermal coefficient of expansion of alumina chip-carriers, heat conduction to accommodate high-power chips, and the high-speed requirement of a low-dielectric-constant board spurred the development of a whole multitude of new substrates, now becoming available (Table 1).

Substrate choices

At this time, Teflon-Fiberglass is finding uses in high-speed circuits because of its low dielectric constant. Copper-invar-copper and the various Kevlar and quartz composite laminates are being used in substrates whose thermal coefficient of expansion nearly matches that of alumina. Polyimide laminates are mainly used in high-temperature, high-power applications.

One of the most interesting materials in Table 1 is thermoplastics, which can be applied to many diverse applications because of their unique mechanical, electrical, and thermal properties. In addition, their cost is relatively low compared with epoxy glass.

Today, three resin systems are being used for thermoplastic extruded and molded boards, with the molded segment experiencing a greater growth, according to David Frisch, product manager at PCK Technology. These are: polyethersulfone (Victrex), from Imperial Chemical Industries Ltd., Wilmington; polysulfone (Udel), from Union Carbide Corp., Danbury, Conn.; and polyetherimide (Ultem), from General Electric Co., Pittsfield, Mass. Unlike epoxy-glass (FR-4 laminate), these materials can be safely wave-soldered and can operate at up to 200°C (Table 2). Glass-filled grades of thermoplastics extend the temperature range to 260°C, permitting the use of vapor-phase reflow soldering and opening up the possibility of a substrate for high-temperature operation or burn-in.

Udel, Victrex, and Ultem can be either molded or extruded. Molding allows features such as component cavities, connector housings, holes, and even legs to be designed into a mold, eliminating many machining and assembly operations. In their extruded forms, these materials are easily drilled, since they are a one-material structure—unlike many two-part laminates such as epoxy glass.

Finally, these thermoplastics can be made transparent, opening up the display area to thermoplastics. For example, the transparent polysulfone board in Fig. 6 is being used in the climate-control panel in a 1984 U. S. sedan (the maker will not disclose which one). The panel contains backlit graphics and membrane switches for controlling heating and air conditioning.

TABLE 1: SUBSTRATE PROPERTIES

Material	Dielectric constant (K)	Coefficient of thermal-expansion (ppm/°C)	Thermal conductivity (W/m °C)	Approximate cost factor
Epoxy-fiberglass	4.5 – 5.0	14 – 18	0.16	1
Polyimide-fiberglass	4.5 – 5.0	15 – 18	0.38	2.5
Teflon-fiberglass	2.5 – 3.5	8	0.25	15
Epoxy-Kevlar	4.0 – 4.5	5.3 – 5.6	0.12	3
Polyimide-Kevlar	3.5 – 3.6	5.6 –5.8	0.15	8
Epoxy-quartz	3.6	5.0	0.17	10
Polyimide-quartz	3.4	6 – 8	0.20	14
Epoxy-graphite	not applicable	3	1.0	not available
Thermoplastics	2.8 – 3.2	20	0.16	1.2
Porcelain-coated steel	6.8	12	1.0 25 (X–Y)	3
Copper-Invar-copper	not applicable	6.4 – 5.8	16 164 (X–Y)	—
Copper	not applicable	17.3	450	7
Alumina	9 – 10	6.5	20	6
Beryllia	9 – 10	8.0	200	10

A principal reason for going to thermoplastic pc boards is their excellent electrical properties. Their most important advantage may be their low loss factor and low dielectric constant (between 3 and 4), vital for high-speed, high-frequency circuitry. Further, the surface resistance of these materials is 10^{10} MΩ, or four decades higher than epoxy glass, which is around 10^6 MΩ.

Until recently, almost all pc-board processing on thermoplastics was done on unclad plastic boards that were either semi-additively or additively plated. Recently, PCK Technology has made available two-sided copper-clad extruded thermoplastic panels, called Tekclad laminates, in both unfilled and glass-filled versions. This development means that pc-board firms with a subtractive etching capability (the great bulk of the U.S. industry) can turn out thermoplastic pc boards.

Plating plastics

So far, the majority of the unclad thermoplastic substrates have been plated with a semi-additive process. Here, after a swell-and-etch step, the entire surface is catalyzed and covered by a thin (0.1-mil) electroless copper layer. Then the rest of the process follows the conventional subtractive etching process. PCK Technology and the Photocircuits Division of Kollmorgen, Glen Cove, N.Y., have tested the new copper-coated, extruded thermoplastic panels in the subtractive plated-through-hole pc-board process and report that the established process needs no modifications to carry it out.

TABLE 2: THERMAL PROPERTIES OF THERMOPLASTIC SUBSTRATES

Property	Polysulfone	Polyetherimide	Polyethersulfone	Epoxy-glass
Heat-deflection temperature at 264 lb/in.^{2}	174° – 200° C	200° – 210° C	200° – 210° C	not applicable
Glass transition temperature	190° – 210° C	215° – 220° C	220° – 225° C	120° C
UL maximum temperature	150° C	170° C	180° C	125° C

For molded boards with nonplanar surfaces, the fully additive Photoformation process, which requires no photoresist, is being used. Here, after a swell-and-etch step, a special photosensitive aqueous coating is exposed to light in the areas where conductors are desired. These areas become catalytic and receptive to subsequent electroless copper deposition, which builds the entire conductor thickness. It is easy to adapt this method for the off-contact exposures needed for boards that have molded on features.

Interest swells

The manufacture of thermoplastic boards, which really only started in early 1982, is beginning to pick up. First into the field was PCK Technology, which is currently concentrating on the fully additive (Photoformation) plating of three-dimensional molded boards. Now at least five other U.S. firms are either engaged in or planning plastic-board facilities. These are: Printex Electronics Inc., Lindenhurst, N.Y., which does semi-additive processing of extruded boards; Kollmorgen's Photocircuits Division (one of the largest independent pc-board processors), which is doing semi-additive and subtractive processing of molded and extruded plastic boards, respectively; Elite Circuits Inc., San Diego, Calif., which is semi-additively plating 3-d molded boards; Plasticorp, Torrance, which uses a special etchless fully additive process on 3-d molded boards; and Circuit Wise Inc., North Haven, Conn., which is setting up a facility to do semi-additive plating of 3-d molded boards.

The pc-board industry, under the pressure to produce fine-line circuits, is due for big changes in the next few years. Laser-exposure systems, CAD, full automation of the process, and, very likely, cleanrooms will find their way to the production floor.

Only the very large independent companies will be able to afford this investment, which may cause the total number of independents to shrink as companies merge or are bought by large electronics manufacturers that need pc-board capacity. At the same time, however, the market share of the resulting hi-tech firms should grow. ☐

CMOS OUTSTRIPS ITS COMPETITORS IN CHIP RACE

Speed and density of complementary-MOS equals that of bipolar and n-MOS technologies; dissipation and reliability are superior to its rivals ☐ *by Fred Jenne*

Most experts acknowledge that complementary-MOS is the technology of the 1980s. But relatively few engineers realize that properly optimized n-well CMOS can now replace virtually all circuits hitherto fabricated in either n-channel MOS or bipolar technologies—at any speed and any level of density.

That possibility is a new thing under the sun, of course. Back in the mid-1970s, each of the three major silicon technologies had its own well-defined position. Bipolar's high speed was offset by its high power consumption. N-MOS could offer low cost, but only at slow speeds. CMOS was favored for low-power applications that could make do with very slow speeds. In those days, bipolar was the speed king, and CMOS occupied the far end of the speed spectrum.

The 1973 p-well version of CMOS was slow for two reasons. Typically, it was less scaled (or shrunk) than n-MOS or bipolar, and it was also a direct descendant of the old, slow p-channel MOS technology. Thanks to the laws of scaling, n-MOS and CMOS caught up to bipolar in speed. In fact, n-MOS has by now actually outrun bipolar in fast TTL applications, leaving only two niches for most new bipolar products: very high-speed emitter-coupled logic and programmable read-only memories. In 1980, CMOS was still slower than n-MOS but mainly because of lingering p-well and scaling problems, not inherent disadvantages.

A technology's fundamental performance parameter is its power-speed product: the power dissipated in an inverter multiplied by the inverter delay, or (to put it differently) the energy that is required to change logic states. MOS technologies improve in power-speed product (or in speed, for constant power dissipation) as the cube of their minimum dimensions. However, bipolar technologies improve only as the first power of the minimum dimension.

For each factor-of-two decrease in line width that has been equally applied to both technologies, CMOS therefore improves by a factor of four as compared with bipolar. Scaling accounted for the rapid reduction of the speed gap between bipolar and MOS in the years from

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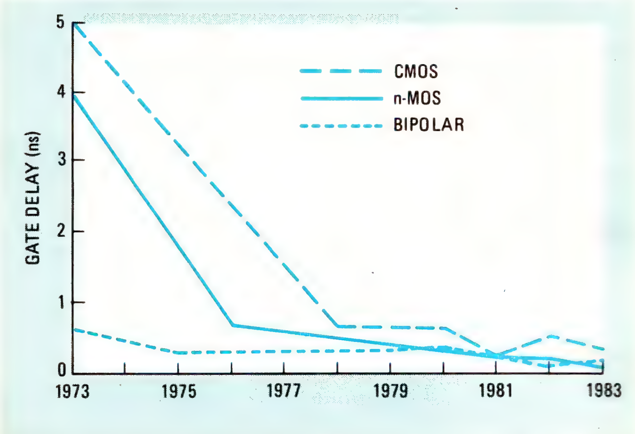
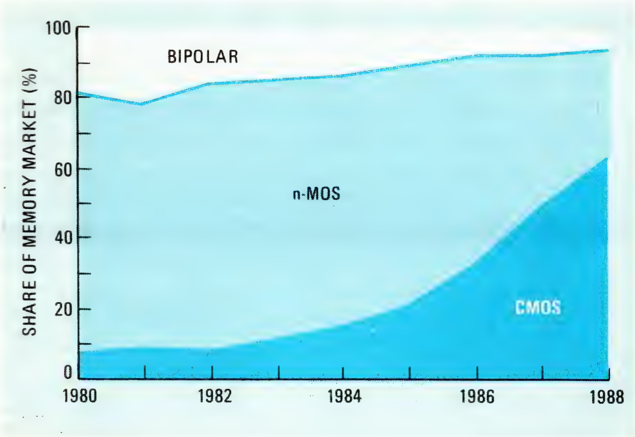
Fred Jenne is vice president of research and development at Cypress Semiconductor Corp., San Jose, Calif.



1. Scaling down. MOS technologies improve in speed-power product as the cube of their minimum dimensions, while bipolar technologies improve only as the first power of the minimum dimension, giving MOS a 4:1 edge as size is reduced.



2. CMOS on the upswing. Offering speeds and densities that are comparable to those of competing technologies, to say nothing of superior dissipation and reliability, CMOS will continue to increase its share of the memory market.

TABLE 1: TYPICAL p-WELL CMOS VERSUS CYPRESS n-WELL CMOS

Parameter	n-well value	p-well value	p-well disadvantage
Substrate doping	50-Ω/cm p^-	5-Ω/cm n^-	higher substrate capacitance
Well doping	1.5E16 phosphorous	1.5E16 boron	—
Body bias	$V_{BB} = -3$ V	none	higher substrate capacitance
Lightly doped drain	n-MOS, p-MOS	neither	higher overlap capacitance; worse hot-electron reliability
Body factor	0.2	0.6	high substrate effect on n-MOS threshold voltage
Electron mobility	600	550	lower because of compensated doping in p-well
Hole mobility	170	190	—

1973 to 1978 and also for the current virtual speed parity among all three of these technologies (Fig. 1).

With today's speed-optimized n-well CMOS, which was derived from the fast HMOS III technology, CMOS has acquired almost all the traits that might make a technology desirable. What's more, scaling has revealed itself as an enemy of bipolar in one area where it used to be quite unchallenged: reliability. With speed and density comparable to those of any technology and power dissipation and reliability superior to those of other silicon technologies, no wonder CMOS is expected to win market share from n-MOS in the years between 1984 and 1988 and to exacerbate bipolar's market erosion, which n-MOS began in 1981 (Fig. 2).

High-speed CMOS

CMOS has been deprecated as a mere watch-chip technology for two significant reasons: low priority at many U.S. firms, and an architecture problem. But surging Japanese CMOS shipments have been noticed, and CMOS is no longer just the "other technology," run on 3-in. wafers in obsolete fabrication facilities; the industry is now using the most modern fab equipment available to scale CMOS to its limits on 5-in. wafers.

As for the CMOS architecture problem, its origins are historical. CMOS can evolve from two different paths, originating from either p-MOS or n-MOS. P-well CMOS technology, which preceded n-MOS, was hampered by the fundamental disadvantages of its p-MOS parent. N-well CMOS incorporated many technological improvements developed during the late 1970s, when n-MOS (HMOS II) successfully attacked the high-speed bipolar TTL market.

When Cypress's n-well CMOS is compared with typical p-well CMOS (Table 1), the only performance parameter that does not favor the one over the other is a slight degradation in hole mobility, which diminishes p-MOS performance somewhat. Even so, looking at the matter in perspective, the entire performance range of p-MOS chips is 200% to 300% poorer than those of companion n-MOS devices. Almost all very high-speed designs are best handled with a mostly n-MOS philosophy.

TABLE 2: COMPARISON OF FAST 1-K STATIC RAMS

	Bipolar	n-MOS	Cypress CMOS
Part number	93422	9122	7C122
Speed (ns)	35	25	15
Power (mA)	155	120	80
Power speed product (nJ)	27	15	6
Electrostatic discharge protection (V)	<400	>1,000	>2,000
Alpha sensitivity	high	none	none
Die temperature* (°C)	135	123	105

*T (ambient) = 70°C; thermal resistance = 80°C/W

Consider one comparison between the modern n-well CMOS technology, on the one hand, and bipolar and n-MOS, on the other—1-K static random-access memories: the n-MOS 9122 and the Cypress CMOS 7C122, a pin-compatible bipolar 93422 (Table 2). In this case, a hidden factor actually favors bipolar. Because the CMOS 7C1222 replaces the original bipolar 93422 RAM, whose level and characteristics were optimized to suit bipolar, the CMOS RAM uses about one third of its total power converting TTL inputs into CMOS internal levels. In a CMOS-level version of the RAM, that power loss would be wholly eliminated.

Reliability gains

In the 1970s, bipolar could not be challenged for reliability, which is influenced by such factors as electrostatic-discharge protection, alpha-particle immunity, and high-temperature operating life (HTOL).

Electrostatic-discharge protection, the ability of input/output pins to withstand more than 1,000 V, clearly favored the hearty bipolar zener diode structure over fragile MOS gate oxide. Alpha-particle immunity—the ability of memory cells to remain undisturbed when bombarded by the alpha radiation that occurs naturally in Cerdip sealing glasses and plastic filler materials—clearly favors the highly capacitive, fully static cells used in bipolar circuits over the charge-storage techniques that predominate in n-MOS.

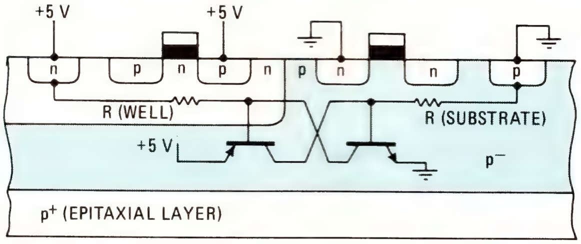
High-temperature operating life favored bipolar because its active devices are bulk transistors not subject to surface effects—that is, to sodium contamination—which created concerns about the reliability of MOS devices in the early years. However, after a decade of experience and of size reductions, the reliability report card that once favored bipolar over CMOS has now been reversed. Improved circuit design and layout have taken CMOS input-protection devices from sub-800-V failure to plus-2,000-V success. (The new MIL-883C standard forces I/O pins to withstand five 2,000-V pulses of each polarity from a 100-pF capacitor through a 1.5-KΩ resistor.) Meanwhile, scaling has degraded bipolar's input-protection capabilities. The standard bipolar input-protection device is an emitter-follower used both as a zener diode to shunt input and as a clamp to prevent input undershoot. Unfortunately, as bipolar transistors were scaled from robust 3-μm-deep structures to fragile 0.4-μm-deep devices, the input-clamp transistor's ability to

The CMOS latchup hangup

The complementary-MOS latchup failure mechanism is caused by the triggering of the parasitic silicon-controlled rectifier, a four-layer pnpn structure inherent in C-MOS. Very simply, latchup occurs when an unwanted trigger current turns on two back-to-back bipolar transistors that regeneratively turn each other on more strongly, in time shorting the power supply to ground and causing the collector supply aluminum line to vaporize. Since the SCR structure in bulk CMOS cannot be eliminated, the latchup control problem is a matter of keeping the SCR turned off. As the figure shows, the well and substrate contacts short the base-emitter junctions of both of the SCR's bipolar transistors. Unfortunately, these shorts have parasitic resistances that allow the transistors to be turned on if about 0.7 V can be generated across them; spurious triggering current can be caused by factors such as input/output overshoot. To improve latchup, the substrate sheet resistance and the well sheet resistance must be minimized. Actually, if either of the two resistances has a low value, the SCR's regenerative feedback is broken and latchup prevented. Thus, the latchup prevention issue involves keeping either or both of these resistances as low as possible. Minimizing the well resistance is difficult because changing well doping levels has an impact on the well transistor parameters.

A simpler but expensive solution is to use epitaxial substrates to reduce the substrate resistance by a factor of 100 to 1,000. The epitaxial solution represents brute force from an engineering point of view and is deficient from a manufacturing point of view. While volume-produced, industry-standard 5-in. 50-Ω/cm p− silicon substrates cost about $20, the equivalent p−/p+ epitaxial substrates range from $45 to $60. Another hidden cost will be the yield loss associated with epitaxial material, which at best can match plain-wafer yield if the epitaxial deposition adds zero defects to its base substrate.

The most attractive prospect is a latchup-free technology using ordinary p-substrates. That state of affairs can be achieved with these relatively minor compromises: all I/O input or output transistors are n-MOS; all I/O devices are separated from the rest of the CMOS chip by a guard ring; and all internal well (p-MOS) transistors have a local well ground contract running the length of the transistor. These techniques provide a latch-current capability greater than 250 mA, while allowing the use of the industry standard p− substrate.



withstand input surges diminished dramatically, to about 200 V, a factor of 10 below the military specification. The culprit is avalanche-induced metal migration, a shorting mechanism actually used to advantage in some bipolar PROMs.

Scaling has also turned alpha particles into a major problem for bipolar. In the large-dimension era, before 1980, the inherent capacitance of any structure could maintain data during 100-μA 100-ps surge-current pulses created when alpha particles hit silicon substrates. Scaling has changed the status quo, however, and now all technologies have lost their capacitive protection because node capacitance is reduced by the square of the scaling factor.

Clear winner

Technologies are now protected only by their inherent immunity to unavoidable, low-level background radiation. In this case, CMOS is a clear winner. CMOS transistors achieve power gain by amplifying gate voltage input into drain current outputs. Bipolar transistors achieve gain by amplifying base current inputs into collector current outputs. Bipolar base current is multiplied by the bipolar gain-constant beta, about 100, regardless of its source, including such unintended current sources as alpha particles. Thus, the bipolar transistor's fundamental gain mechanism has created an inherently reliable failure mechanism.

If the choice of CMOS technology were to be made strictly on the basis of performance or ease of manufacture in existing n-MOS fab lines, n-well CMOS would be the only choice for the next generation of CMOS. But the confusing issue of CMOS latchup has managed to obscure such traditional decision-driving issues as power, speed, and even manufacturing cost (see "The CMOS latchup hangup").

With proper layout and the use of a bias generator, n-well CMOS can be made so immune to latchup that the current that is needed to induce it is high enough (250 mA) to cause heating damage to the device under test before latchup even occurs. Before 1975, many HTOL failure modes were caused by destructive contaminants, and MOS surface technologies were particularly susceptible to such environments. However, today's technologies are processed in much cleaner environments and passivated with much more impervious materials, for instance, silicon nitride.

Again the winner is CMOS because it has the lowest power dissipation and thus the lowest chip temperature for a given level of product complexity. Lower chip temperatures mean that the failure rate for thermally activated failure modes is exponentially lower. A typical failure mode with a 1.0-eV activation energy will be aggravated to failure 480 times more often in bipolar than in a "perfect" technology—one that draws no power. The CMOS failure rate is 10 times higher than that of the perfect technology; CMOS therefore improves on bipolar by a factor of 48. ☐

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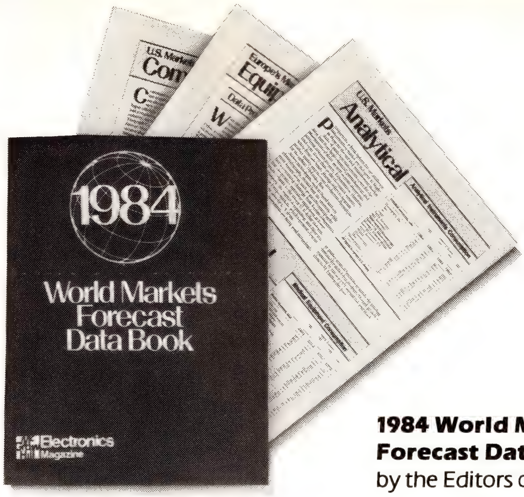

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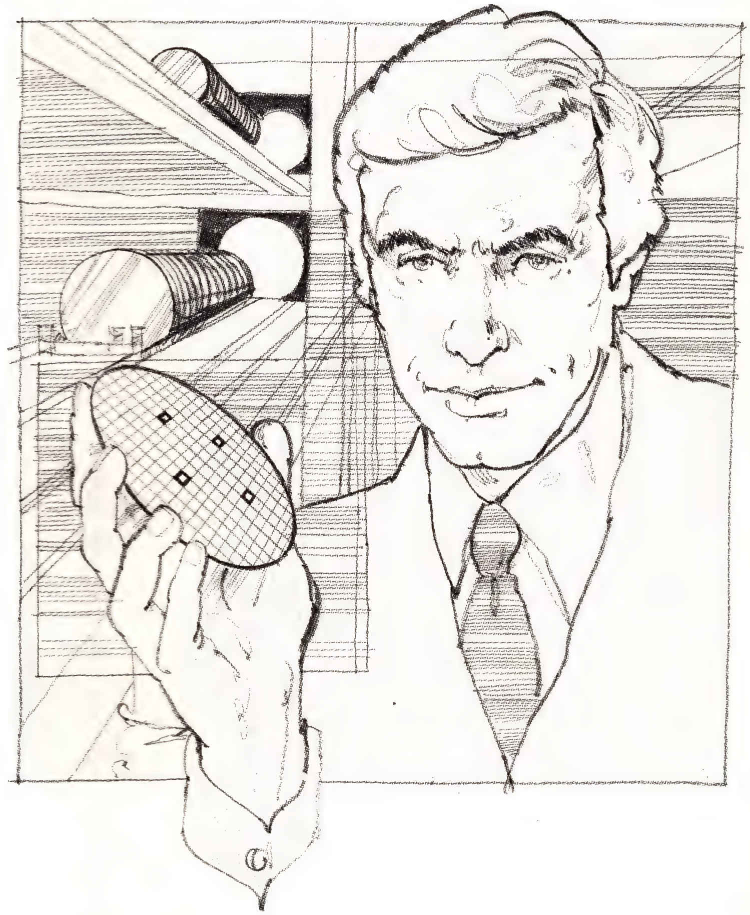

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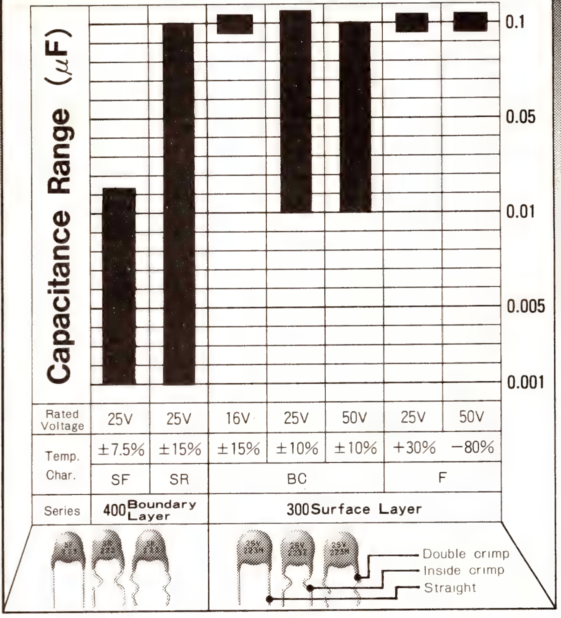

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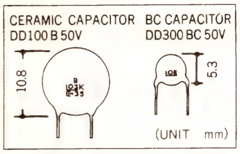

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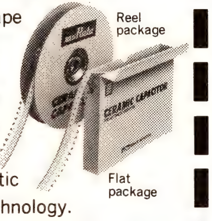

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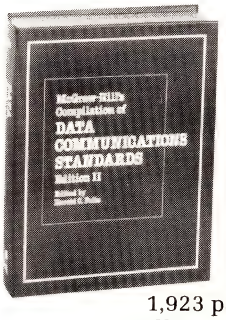

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FUSE ARRAY CUSTOMIZES CONTROLLER

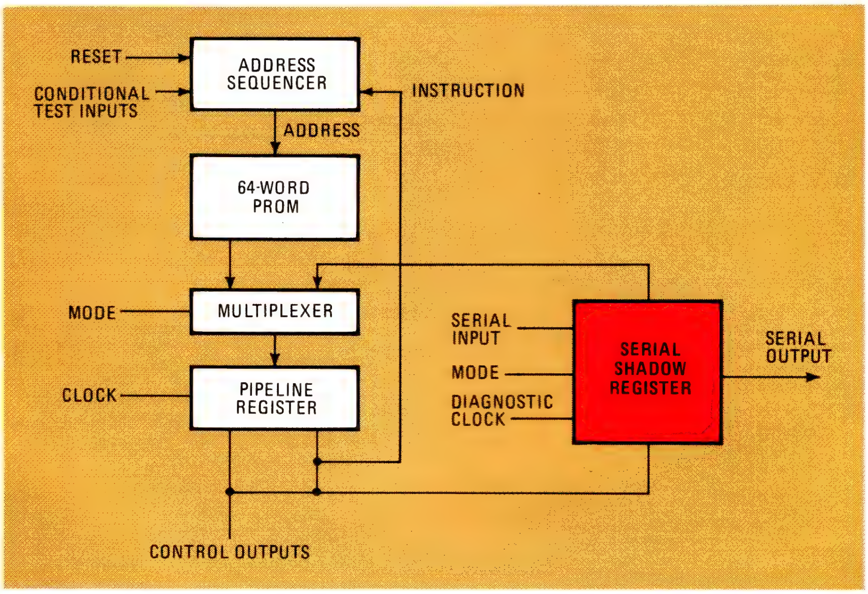
Microinstructions, rather than equations, program 20-MHz microcontroller through an algorithm similar to the one used for PALs ☐ *by Steve Zollo*

Incorporating bipolar fuse-programmable read-only memory technology in a logic chip, the Am29PL141 single-chip microcontroller permits designers to implement complex state machines and controllers. The 20-MHz (50-ns instruction cycle) circuit is programmed with microinstructions rather than Boolean equations. The fuse-programming algorithm is almost identical to the one used for American Micro Devices's programmable-array-logic family.

"The Am29PL141 is the first integrated circuit to incorporate logic in a fuse array," says Deepak Mithani, senior product marketing engineer. "It is more than 65% logic."

The IC incorporates 64 words of control storage, a sequencer, 32 bits of pipeline registers, and an option that provides in-system testing.

The chip allows distribution of intelligent control throughout the system. Designers can offload tasks from the central controller by distributing various 141s as the control circuit for self-contained functional units such as input/output, interrupt handling, bus control, diagnostics, and arithmetic and logic units. Chris King, product marketing manager for the 2900 family of bipolar parts, says the 141 can be used in superminicomputers, robotics, data-acquisition systems, and in controllers for computer peripherals.



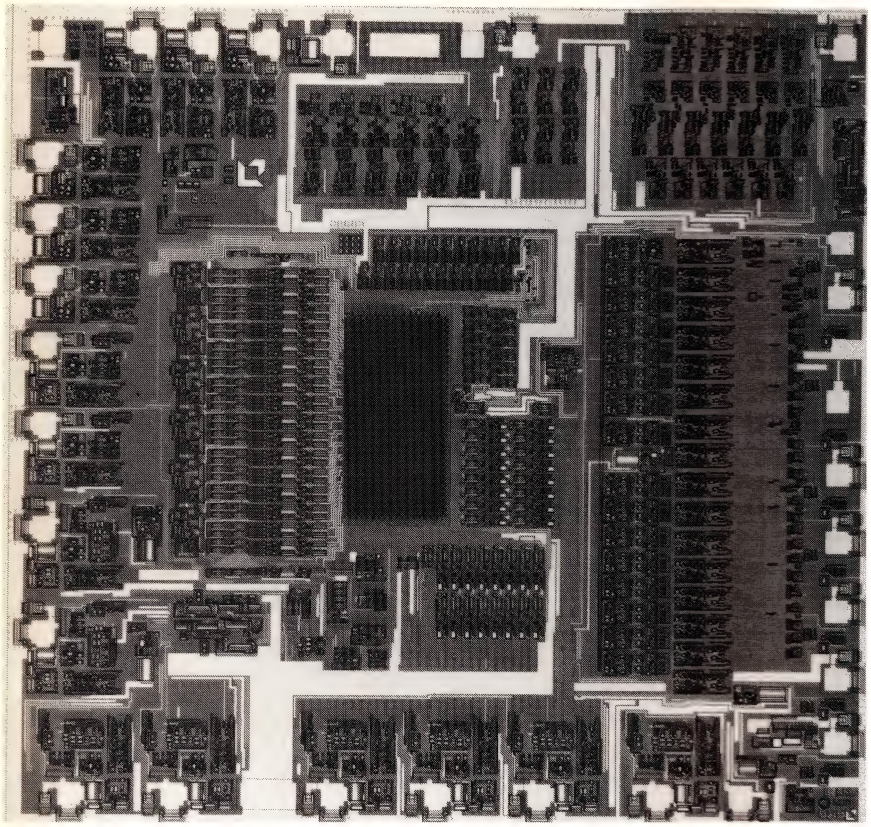
Testable. An optional portion of this circuit from Advanced Micro Devices, the Serial Shadow Register, permits in-system testing. Problems down to the IC level can be found.

The controller consists of four main logic blocks: the microprogram memory, microaddress-control logic (sequencer), condition-code-selection logic, and microinstruction decoder. Its heart is an address sequencer that provides the microprogram address to an internal 64-word-by-32-bit PROM. The sequencer supports high-level microinstruction functions, including conditional branches, subroutine calls and returns, and loops.

The microprogram memory contains all the user-defined instruction-flow and output sequences. The condition-code-selection logic, as its name implies, selects the condition-code input to be tested when a conditional microinstruction is executed. The microinstruction decode generates the control signals necessary to perform the microinstruction specified by the microinstruction part of the microword.

On-board PROM. The controller's memory is a 64-word-by-32-bit PROM with a 32-bit pipeline register at its output. The upper 16 bits of the register stay internal to the controller and form the microinstruction to control address sequencing. The lower 16 bits are brought out as user-defined control outputs.

As a programmable option, the Am29PL141 may be configured to contain AMD's proprietary Serial Shadow Register diagnostics capability, which is a simple, straightforward method of in-system testing. With it, problems can be isolated down to the IC level. The diagnos-



tics configuration activates a 32-bit-wide D-type register, called a shadow register, on the pipeline-register inputs. The shadow register can be serially loaded from the serial data-input pin, loaded in parallel from the pipeline register, or held. The pipeline register can be loaded from the microprogram memory in normal operation or from the shadow register during diagnostics.

Executing tests. Serially loading a test microinstruction into the shadow register and loading the contents of the shadow register in parallel into the pipeline register forces the execution of the test microinstruction. The results of the test can then be clocked into the pipeline register, as in normal operation, loaded in parallel into the shadow register, and shifted out serially for system diagnostics.

To support the controller, AMD is introducing M29, a software package for assembling microinstruction programs that runs on a Digital Equipment Corp. PDP-11 or VAX computer. In addition, AMD's System 29 development system is being fitted to handle the new chip. Arrangements are being made with Data I/O of Redmond, Wash., a manufacturer of PROM programmers, to supply programming. Some of Data I/O's equipment already can interface with PDP-11 and VAX computers.

The Am29PL141, which can generate 16 user-programmable signals every 50 ns, can be cascaded without loss in speed. Samples will be available in September, priced at $95 each in lots of 100.

Advanced Micro Devices Inc., 901 Thompson Pl., P.O. Box 453, Sunnyvale, Calif. 94086. Phone (408) 732-2400 [Circle reader service number 338]

SOFTWARE

Integration comes to Unix systems

An office software system called Alis offers computer intelligence, communications facilities for group support, a multiwindow user interface, and a portable open-system design. With it, users can combine text, drawings, business graphics, spreadsheets, and data-base information into one document and still be able to edit each separate portion in its original form.

Written in C and running under the AT&T Bell Laboratories' Unix operating system, Alis can support Unix-based bit-mapped work stations or personal computers, as well as multiuser Unix systems supporting users at terminals. An intelligent document composer with multiple fonts provides continuous formatting assistance during text creation and editing.

Available to original-equipment manufacturers in November, Alis costs $1,350 per user for bit-mapped work stations and $900 per user for terminal-based users.

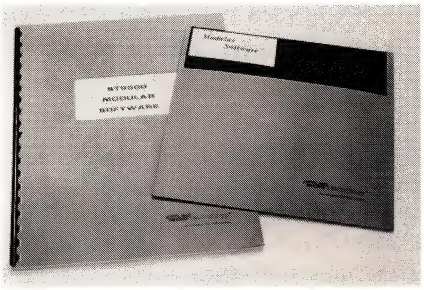
Applix Inc., 302 Turnpike Rd., Southboro, Mass. 01772.
Phone (617) 481-4721 [Circle 340]

Software programs reduce STD bus development time

Modular Software, a package of software programs, reduces the time needed to integrate the company's STD bus board-level products. The programs help system integrators and development engineers by making the STD bus card operational more quickly.

The package can be linked with other assembly language programs to form a stand-alone program and arranged into modules linked with other modules by a special loader. Software also provides for a menu-driven program specifying a special configuration for one or more board types, or the package can be saved on disk and later recalled as a unified module. Finally, the modules and the module manager can be loaded in memory to provide interaction with a high-level program language.

Each disk comes on a 5¼-in. or 8-in. format with a configuration program, loader, module manager, and sample program with single or multi-



ple board attributes. Available now for products in the company's input/output and special function groups, Modular Software lists for $250.

Applied Micro Technology Inc., P.O. Box 3042, Tucson, Ariz. 85702.
Phone (602) 622-8605 [Circle 342]

DISK DRIVES

Memory units with backup serve LSI-11s

Geared for LSI-11 microcomputer systems, the CI-820 Winchester disk drive subsystem, with formatted capacities of 10, 20, or 40 megabytes, contains a 2-megabyte dual floppy-disk-drive or streaming-tape-drive backup. The CI-820 uses a 22-bit direct memory access controller for both floppy-disk and Winchester drives. The drives have an average access time of 40 ms and a transfer rate of 625-K bytes/s.

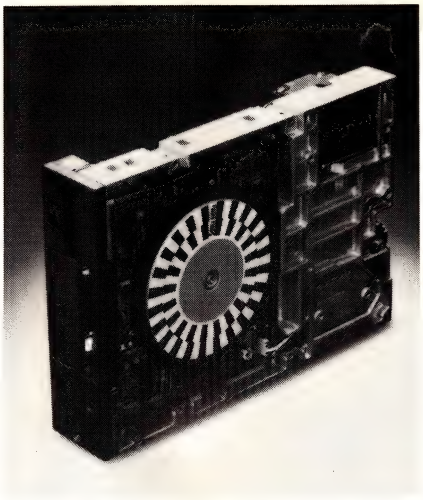
The CI-820 operates under existing system software and diagnostics without modifications. The subsystem is compatible and interchangeable with Digital Equipment Corp.'s RL01 and RL02 Winchester drives as well as RX01 and RX02 floppy-disk drives. The emulation permits software transparent operation under RSTS-E, RSX11M, RSX11M+, RT-11, and AT&T Bell Laboratories' Unix operating systems.

Unit prices are $4,495 for the 10-megabyte model, $4,995 for the 20-megabyte version, and $5,995 for the 40-megabyte system.

Chrislin Industries Inc., 31352 Via Colinas, No. 101, Westlake Village, Calif. 91362.
Phone (818) 991-2254 [Circle 343]

IBM-compatible disk drive stores up to 500-K bytes

An IBM-compatible 5¼-in. floppy-disk drive called the ND-04D is said to simplify system integration thanks to a slim design and compact dimensions. For improved accuracy, the drive incorporates a direct-drive system with a brushless dc motor.



The double-density drive's unformatted recording capacity is 500-K bytes. Average access time is 65 ms and average latency time is 100 ms. The heads move from track to track in 5 ms, and the disk rotates at 300 revolutions per minute. Available now, each ND-04D sells for $375.

Toshiba America Inc., Information Systems Division, 2441 Michelle Dr., Tustin, Calif. 92680.
Phone (714) 730-5000 [Circle 344]

LOCAL NETWORKS

Module links serial port to one node

The ARCnet-Link module provides an interface between equipment with a programmable asynchronous RS-232-C serial port and an ARCnet local network. The module is a self-contained unit which links one RS-232-C serial port to one node.

The ARCnet-Link incorporates a COM 9026 local network controller and a COM 9032 local network transceiver circuit to provide protocol handling in a minimal-sized module. It also incorporates a simplified protocol for communication through the RS-232-C. A 2-K-byte data-packet buffer is used to provide four pages of packet storage, which can be user-defined to provide double buffered transmit and receive functions. Switch selection of baud rates from 1,200 to 19,200 baud links the module to the RS-232-C port.

Two models—one for connection to 110 V ac, 60 Hz, and another for 220 V ac, 50 Hz—are available now. Both are priced at $995 each.

Standard Microsystems Corp., 35 Marcus Blvd., Hauppauge, N.Y. 11788.
Phone (516) 273-3100 [Circle 347]

Option builds networks at less than $100 per user

An option for the CompuPro 10 multiuser microcomputer lets as many as 16 users on four nodes be networked for less than $100 per user. The Net 10 uses Datapoint Corp.'s ARCnet protocol and requires only a passive hub and RG62 coaxial cable to connect four of the company's four-user systems.

Net 10, which permits nodes to come on line or go off line transparently, features a 2.5-Mb/s direct-memory access, is fully interrupt-driven, and uses on-board timers to avoid error lockouts. As many as 255 nodes can be linked over distances of up to four miles, but for more than four nodes to be networked, one active hub is required.

Net 10 incorporates a number of security features. For example, logical drives can be marked private so users can access only certain drives on a node, and passwords can be required to log onto a designated node. Other features include a utility that allows printer functions to be mapped across the network, the mapping of queues to facilitate file sharing, and multiple users being able to use the network at the same time. Current CompuPro 10 users will receive an upgraded operating system free of charge.

Expected to be available in September, Net 10 is priced at $395.

CompuPro, 3506 Breakwater Ct., Hayward, Calif. 94545.
Phone (415) 786-0909 [Circle 390]

INTEGRATED CIRCUITS

CMOS arrays boast 2.5-ns gate delays

The GA series of complementary-MOS gate arrays includes the MK GA1000D, with the equivalent of 1,152 two-input NAND gates; the MK GA2000D, with the equivalent of 2,016 gates; the MK GA3000D, with the equivalent of 3,016 gates; and the MK GA4000D, with the equivalent of 4,080 gates.

All four generic arrays are fabricated using a 3-μm, twin-tub CMOS process that uses double-level metal for an interconnection. This process, which includes 1.8-μm effective gate lengths, yields parts with typical loaded on-chip gate delays of 2.5 ns.

A fully integrated computer-aided design system can be used with the GA series. The CAD system includes logic simulation, critical-path analysis, automatic place and route, testability analysis, and fault simulation, as well as test-program-generation capabilities.

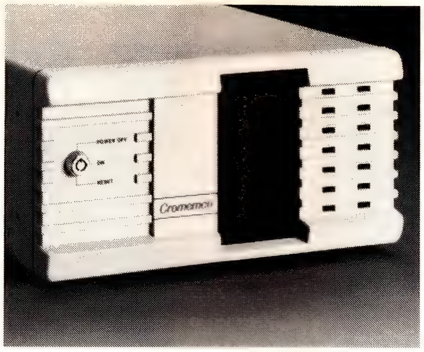
In quantities of 1,000, prices for the four gate arrays range from $9.30 each for the GA1000D in a 40-pin plastic dual in-line package to $45 each for the GA4000D housed in a 84-pin plastic pin-grid array. All four are available now.

United Technologies, Mostek Corp., 1215 W. Crosby Rd., Carrollton, Texas 75006.
Phone (214) 466-6027 [Circle 346]

MICROCOMPUTERS

Two Unix-based microcomputers handle 16 users

The System 100 and System 300 series multiuser microcomputers are based on the AT&T Bell Laboratories Unix System V operating system with Berkeley enhancements. Memory can be expanded on the systems up to 16 megabytes of error-correcting random-access memory.



The systems can accommodate up to 16 users and include very high-speed operation, large internal memory, a 68000 10-MHz central processor, cache memory for disk-drive operations, and expansion capability.

A 50-megabyte Winchester disk drive with a controller is standard. The controller includes a dedicated microprocessor and four-track cache memory that automatically verifies information written to the disk with a read-after-write cycle to ensure data integrity. Floppy-disk drives are also included.

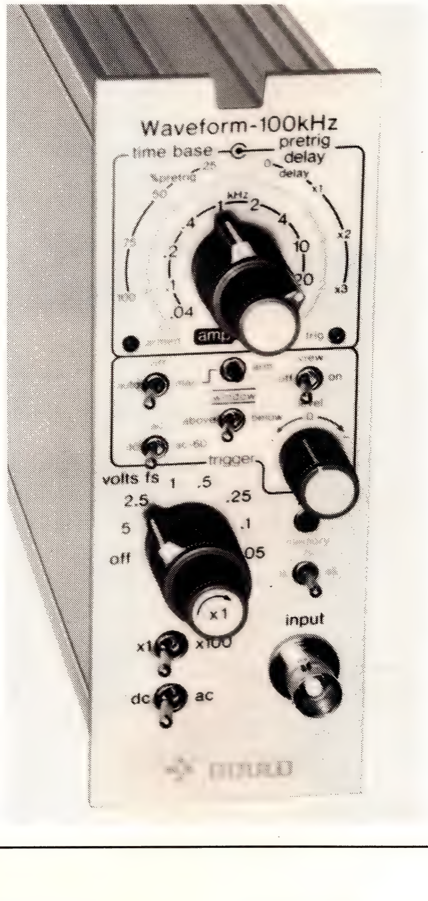
Prices range from $9,995 for a System 100 with 512-K bytes of RAM to $19,995 for a 2-megabyte System 300. All are available now.

Cromemco Inc., 280 Bernardo Ave., Mountain View, Calif. 94303.

INSTRUMENTS

Waveform storage module analyzes 100-kHz signals in real time

A high-frequency waveform storage module, the model 13-4616-20, is said to provide a sample rate 10 times as fast and an internal memory twice as long as previous modules did. Capable of analyzing waveforms up to 100 kHz in either storage or real-time modes, the module also captures transients as fast as 3 μs.



Throughout its dc-to-100-kHz frequency-response range, the module has a sensitivity range from 50 mV to 500 V full scale. An optional high-voltage probe extends sensitivity to 1,500 V.

In the automatic-triggering mode, the waveform module captures and records random transients or off-limit signals in the order of their occurrence. In the manual-triggering mode, the unit captures, stores, and plots one-shot events. The company says the unit can also be set to trigger above a preset level, below a preset level, or above and below a preset window.

The 13-4616-20 has an internal, two-pole, high-pass trigger filter that rejects low frequencies and captures high-frequency transients when they are within the low-frequency waveforms. Another filter, an active four-pole low-pass circuit, has minimum sine-wave distortion and minimum overshoot on square waves. Operating at a fixed data output rate of 200 samples/s, this filter effectively removes spurious high-frequency components from the digital-to-analog converter's output.

The model 13-4616-20 waveform storage module is priced starting at $2,190 in single-unit quantities. Delivery takes 60 days from receipt of order, according to the company.

Gould Inc., Recording Systems Division,
3631 Perkins Ave., Cleveland, Ohio 44114.
Phone (216) 361-3315 [Circle 350]

MODEMS

300-baud auto dialer goes for $159

The Password 300 asynchronous automatic dialing and answering modem is priced at $159. Small enough to fit in a briefcase, tool kit, or coat pocket, the Password transmits data at 300 baud.

A computer can instruct the modem to automatically dial, answer incoming calls, and put the caller in contact with the computer. When a transmission is completed, the Password 300 resets itself to wait for the next incoming or outgoing call.

It also has a speaker to monitor dial tone, ringing signal, and carrier detection. It can be set to monitor data transmission and to shut off automatically when a phone link is established. A light-emitting diode indicates power on and ready to go.

Measuring 6.4 by 4.4 by 1.4 in., the Password 300 weighs 1 lb and is available now.

International Data Sciences Inc., 7 Wellington Rd., Lincoln, R.I. 02865.
Phone (800) 437-3282 [Circle 360]

4,800-baud modem serves switched-line networks

The model 7164-0200, the newest addition to the company's 7160 series of diagnostic modems, is a 4,800-baud switched-line modem for point-to-point network configurations. Fully synchronous, it operates over unconditioned, voice-grade lines in half-duplex mode and uses mainstream diagnostics.

The 7164-0200 uses digital signal processing for 98% of its functions, including modulation, demodulation, and dynamic equalization. This is reported to benefit the user because it ensures faster problem determination and fewer difficulties with problem lines, as well as freedom from component drift.

Diagnostics can be initiated automatically by the host or by the computer. Diagnostic tests include a self test, local analog loop test, local modem status report, local/remote status report, remote data terminal equipment interface status report, and lamp test.

Available during the third quarter of 1984, the 7164-0200 can be rack mounted on standard 19-in. racks. Prices start at $3,850.

NCR Comten Inc., 2700 Snelling Ave. N.,
St. Paul, Minn. 55113.
Phone (612) 638-8400 [Circle 361]

PROM BURNERS

Software fits programmer to user's needs

The Series 22 programs all MOS and complementary-MOS erasable programmable read-only memories and allows PROM users to tailor a programmer to specific needs. Software options for programming new families of devices can be added. More than 20 options are currently available.

Twenty-seven data-transmission formats, including four 16-bit formats, RS-232-C and 20-mA serial input/output, a data editor, and remote-control software, are standard on all versions of the system. Optional PROMlink software offers an alternative to stand-alone operation. All operations are menu-driven, and program data files can be stored on, altered, and retrieved from the floppy disk.

Available now, the Series 22 ranges in price from $1,995 to about $4,500, depending on options.

Data I/O Corp., 10525 Willows Rd. N.E.,
Redmond, Wash. 98073.
Phone (206) 881-6444 [Circle 357]

INDUSTRIAL CONTROLS

Boards build multiprocessor control units

The IMP 68000 industrial multiprocessor computer is based on a family of single-board computers with on-board usable input/output. Each board can be used individually for industrial-control and data-acquisition applications. Up to eight boards can be combined to provide a multiprocessor system.

Each IMP 68000 processor board contains a complete I/O subsystem ready for direct interface; all elements of a complete control system are contained on each board. With the on-board I/O, controlling stepping motors and counting or generating high-frequency pulse trains with no external circuitry are possible.

Up to 128-K bytes of local static random-access memory or erasable programmable read-only memory, interrupt-handling logic, a 1-kHz real-time clock, and on-board diagnostic circuitry are also included on the 68000-based board. Epoxy-encapsulated thick-film modules are used to replace discrete components. Prices for the IMP 68000 range from $942 to $2,894, with delivery within 30 days of ordering.

Indocomp Inc., 5409 Perry Dr., Drayton Plains, Mich. 48020.
Phone (313) 568-5962 [Circle 363]

Unit controls and measures currents or kilowatts

A current controller called the Model A is designed to measure and control currents or kilowatts with response speeds appropriate to the electrical signals. Where energy must be controlled, the Model A provides process control of electrical parameters—including current, voltage, and kW, ac or dc—for applications in arc melting, electro slag, chemical rectification, and glass processing.

The current controller also has proportional, reset, and rate modes with front-panel adjustments for setpoint, manual output, and alarm limit, and automatic transfer from manual to automatic in response to a feedback signal. Process input is from 0 to 5 V and is field-changeable to 0 to 50 mV or 0 to 100 mV. Control output is from 0 to 20 mA. Available now, the Model A lists for $2,150 each.

Macrocamp, 100 Henry Station Rd., Uklah,
Calif. 95482.
Phone (415) 472-7033 [Circle 364]

RESISTORS

Resistor net exceeds military specifications

A series of low-profile high-precision resistor networks in single in-line packages, called TaNFilm 4900, is the company's second line to conform to the new military specifications for low-profile-resistor-network configurations. The series is said to exceed the performance standards for the mechanical specifications of MIL-REL-83401 for low profile 6-, 8-, and 10-pin SIP resistor-network configurations.

Temperature characteristics are uniform among all resistors within each network, with temperature coefficients to ±25 ppm/°C and standard tracking of 5 ppm/°C. Resistance tolerances offered include ±0.1%, ±0.25%, ±0.5%, and ±2% with resistance ranges extending from 20 Ω to 100 kΩ.

The networks' operating temperatures range from –55°C to +150°C and have an on-board height of 0.187 in. and a width of 0.074 in.

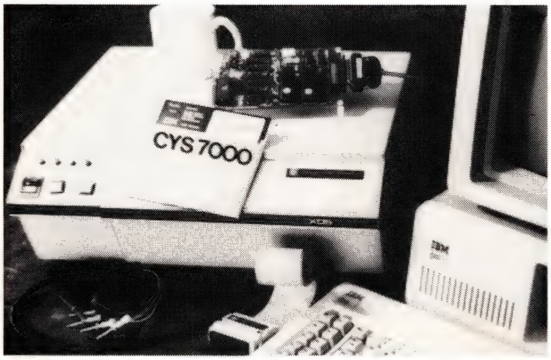
Depending on pin count, standard-tolerance 4900 Series networks are priced from $1.40 to $3.30 each in 1,000-lot quantities. Available now, delivery takes from 8 to 10 weeks.

TRW Electronics Components Group, 4222
S. Staples St., Corpus Christi, Texas
78411. Phone (512) 992-7900 [Circle 351]

DEVELOPMENT SYSTEMS

Package turns an IBM PC into a TMS 7000 system

The CYS-7000 package for converting the IBM Corp. Personal Computer into a TMS 7000 development system consists of two parts. The first is a software package that runs on the PC, communicates with the Texas Instruments Inc. XDS and EVM development systems, and provides the cross-assembler and interface routines for the programmer. The second is an external board that connects to the RS-232-C port of any computer and programs the assembled code into a 24-to-28-pin erasable programmable read-only memory.



The software package contains a symbolic assembler, which takes the standard TI mnemonics as source-code input and generates a listing and an Intel-format Hex file as output. The software runs under PC-DOS or MS-DOS version 2.0 and communicates with the XDS and EVM systems by converting the PC into a terminal emulator.

The package also includes a set of driver routines which send the Intel-format Hex file over the RS-232-C port to the programmer board, one line at a time. The programmer board generates a reply after each line, indicating if programming was successful or unsuccessful, or if there was a transmission error. It works with any computer having an RS-232-C port and can be driven by the CYS-7000 software for the personal computer.

The board uses Hex format files to program, compare, or read a part. Available now, the CYS-7000 assembler software lists for $195; the CYP-27xx programmer board sells for $245.

Cybernetic Micro Systems, P.O. Box 3000,
San Gregorio, Calif. 94074.
Phone (415) 726-3000 [Circle 354]

IC EQUIPMENT

Fine-line screen printer puts tungsten on green ceramic tape

The Accu-Coat Model 3230 printer, a 12-by-12-in. screener with registration to 0.0003 in. and the ability to fill via holes, may be used to screen tungsten metallization on green ceramic. This is then used to produce the multilayer ceramic motherboards and chip carriers required for high-density, very high-speed integrated circuits.

The printer can screen tungsten on green ceramic tape with extremely close layer-to-layer registration, thus producing both multilayer packages and chip-carriers for high-density VHSICs. The screen's capacity, with a 9-by-9-in. maximum print area, permits fine-line screening down to 0.002 in. with no snap-off between screen and substrate, thus reducing line distortion.

The electronically controlled via-hole-filling option allows automatic repeat screening to ensure uniform ink penetration and layer-to-layer conductivity.

The price for the model 3230 screen printer is in the $10,000 range. The company is accepting orders on the printer, with delivery running about 8 to 10 weeks.

Aremco Products Inc., P.O. Box 420, Ossining, N.Y. 10562.
Phone (914) 762-0685. [Circle 353]

PERSONAL COMPUTERS

DOS, CP/M give portable a large software base

Weighing in at 14 lb, the Eve II portable computer has a 5-in. monitor, two 5.25-in. half-height disk drives, and a full-size typewriter-style keyboard with numeric keypad. The unit measures 5 by 15 by 14.5 in.

The Eve II has 64-K of random-access memory and both the 6502 and Z80 microprocessors. Standard Apple-compatible DOS and CP/M operating systems give it a wide software base. Standard interfaces include an RS-232-C serial port, a Centronics parallel-printer port, a joystick port, and an external monitor jack.

Contrast and brightness controls for the monitor are mounted on the front, as are the switch controlling column width (40 or 80 characters) and the power-on and -off switch.

A canvas carrying bag holds disks, manuals, and power cables. Available now, the Eve II Portable Computer lists for $1,595.

Computer Technology International Inc., 200 Murray Hill Pkwy., East Rutherford, N.J. 07073.
Phone (201) 935-9300 [Circle 355]

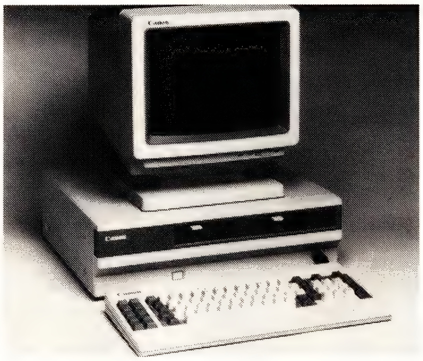
Machine runs IBM software without modifications

An IBM-compatible personal computer includes a range of applications software for word processing, spreadsheet, data-base management, accounting, and data communications. IBM-compatible software that can run without modification includes Lotus 1-2-3, SuperCalc 3, dBase II, and flight simulation.

Standard features include a 16-bit 8086 microprocessor, serial and parallel interfaces for connection to either printers or data communication devices, 256-K bytes of memory, two double-sided double-density disk drives with 360-K bytes each, and MS-DOS Version 2.1 and a Basic programming language.

Two models, with either a monochrome or color monitor, are available. The monochrome model, priced at $2,495, has a 12-in., nonglare screen of 25 lines by 40 or 80 characters. The color model, selling for $2,995, has the same screen but displays 16 colors. Resolution is 640 by 200 pixels in black and white, and 320 by 200 pixels in color.

Canon USA, Systems Division, 1 Canon Plaza, Lake Success, N.Y. 11042.
Phone (212) 490-0300 [Circle 356]



COMPUTER GRAPHICS

Unit can access host-resident graphics

Compatible with the IBM Corp. 3270 Personal Computer, the Series 70 personal work station can handle personal computer graphics as well as 3279-S3G host-resident-based graphics. Users of the system, which displays up to 16 colors in the PC graphics mode, can create high-resolution business graphics.

In addition, it can run programs such as Lotus 1-2-3, VisiCalc, and WordStar without any modification. Along with its graphics capabilities, the Series 70 also supports a windowing feature, with which the user can view up to seven windows at one time.

With the 3279-S3G emulation feature, the Series 70 can also access and display host graphics. This feature supports programmed symbol sets and an eight-color display. Available in the fourth quarter, the minimum configuration of the Series 70 sells for $5,711.

Lee Data Corp., 7075 Flying Cloud Dr., Minneapolis, Minn. 55344.
Phone (612) 828-0300 [Circle 366]

Graphics enhancement gives PC wide palette

Two enhanced versions of the IBM Corp. 3270 Personal Computer, the PC/G and PC/GX models, offer desktop functions with which users can create and change graphics, zoom in on details, or create drawings. The models display charts, diagrams, or drawings in multiple windows and print them on the company's desktop ink-jet printer using a control program and enhanced host programs.

The 3270 PC/G and GX can receive picture data from host computers in shorthand vector form and can manipulate a picture locally. The color displays of the 14-in. PC/G and 19-in. GX are suitable for developing and managing projects such as building layouts and budgets. The PC/G has an eight-color display with 720-by-512 user-addressable points. The GX color and monochrome work stations have a higher performance capability and resolution, as well as advanced graphics functions. The GX display has 960-by-1,000 user-

addressable points, each of which can be displayed in up to 16 colors. On the monochrome model, each point can be displayed in four shades of gray.

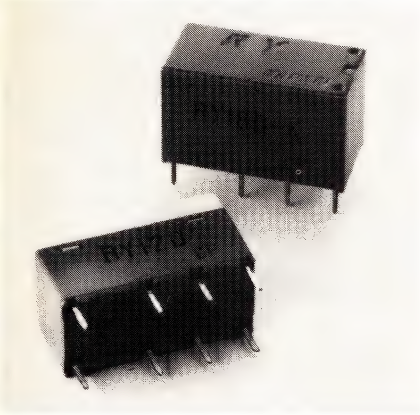
The most basic PC/G system sells for $9,535, the PC/GX for $16,785. Deliveries of the work stations, which can be used as stand-alone computers, begin next quarter.

IBM Corp., Information Systems Group, 900 King St., Rye Brook, N.Y. 10573. Phone (914) 934-4488 [Circle 368]

COMPONENTS

Board relay in DIP handles low voltages

Designated the RY-D, a dual in-line package relay features double-pole, double-throw, make-before-break contacts with a switching range from very low-voltage dry circuits to up to 0.5 A. High reliability is ensured with silver palladium plating overlaid with gold.



Measuring 0.366 in. wide, 0.492 in. high, and 0.795 in. long, the low-profile relay weighs 0.18 oz. It consumes just 0.2 W in operation and can withstand variations in temperature ranging from –30°C to +70°C. The relay comes in a washable version as well.

The product, which is available within 12 weeks after receipt of order, sells for $2.35 each in 1,000-piece quantities.

ITT Corp., ITT Components Division, 3201 S. Standard St., Santa Ana, Calif. 92705. Phone (714) 751-3900 [Circle 370]

PERIPHERALS

Light pen for computers sells for $10

A compact fiber-optic light pen for medium-resolution, low-cost applications can be used with business, industrial, and personal computers. The package consists of a 5.7-in.-long pen, 4 ft of fiber-optic cable, and a 3.7-in.-long fiber-optic link that plugs into the computer.

The light pen offers immunity from both electromagnetic interference and radio-frequency emissions. In addition, it features color compensation, low-light-level sensing, error-fault rejection, and ambient-light rejection.

The pen's spot size is typically 0.08 in., and it requires three lines for operation—voltage source, ground, and output. It has a maximum propagation delay of 1.0 μs and uses an operating supply voltage of 4.75 V to 5.25 V, with an output sink/source current of 1.75 mA.

Intended for use with such software packages as games and medical, engineering, and business programs, the pen carries a price tag of $10 plus modification costs when ordered in quantities of 100,000 or $20 in lots of 10,000.

Honeywell Optoelectronics Division, 830 East Arapaho Rd., Richardson, Texas 75081. Phone (214) 234-4271 [Circle 377]

TEST EQUIPMENT

Voltage tracer detects up to 240 V, ac or dc

The Model 915 voltage tracer is a pocket-size, cordless tester that can trace voltage presence, ground faults, and defective fuses, or identify hazardous electrical equipment. Battery operated (with two AAA penlight cells), the 915 has a built-in solid-state high-gain amplifier and an integral indicator lamp that glows when its single-blade probe touches a surface with voltage.

The voltage tracer operates from 6 to 240 V ac or dc, with no indication whether the blade is at ground potential. Poorly grounded wiring systems, equipment, or lines with induced voltage will cause the tracer to glow dimly—a useful feature in farm environments prone to stray or "tingle" voltages.

The Model 915 is safety designed and tested at 1,500 V. An epoxy-imbedded input resistor protects it against moisture and arc-over. The tester sells for $19, including a protective carrying case, and is available for immediate delivery.

Triplett Corp., 1 Triplett Dr., Bluffton, Ohio 45817. Phone (419) 358-2400 [Circle 359]

CAD

Kit enables terminals to do analysis work

Two packages add power and capability to the 4115B and M4115B display terminals. The model 4115F58 three-dimensional wireframe kit has an 80286/7 processor set, firmware, microcode changes to the 4115B, a keyboard, and ports to simultaneously support a joystick and mouse.

The kit is useful in such tasks as structural analysis and design, finite element modeling, and thermal and vibration analysis. In addition, it makes parallel and perspective projections possible.

The model 4115P51 is a software package that is downloaded from a host or loaded from a local disk into existing 4115Bs. One feature facilitates more efficient implementation of host-based window-management functions. Another allows segment subroutines to be stored in a hierarchical structure more in line with most host-program structures, so that users can reference a segment from within other segments. Thus only one copy of any segment needs to be stored.

With its general segment-editing function, defined segments can be easily altered instead of totally recreated. The fourth feature lets the user of the 4115B define circular arcs by specifying three points. Once defined, the vector representation of the arc is drawn automatically.

The 4115F58 3D kit sells for $6,000 and will be available in February 1985. The 4115P51 package, available now, sells for $1,000.

Tektronix Inc., P.O. Box 500, Beaverton, Ore. 97077.
Phone (503) 644-0161 [Circle 396]

CAPACITORS

Device has high capacitance for its size

A capacitor intended for use in products that are built under size and weight restrictions offers a capacitance value of 0.0028 to 1.2 f, a voltage range of 5 to 100 V dc, and an operating life of 1,000 h at full-rated voltage.

The series 3195 computer-grade, aluminum electrolytic capacitor combines a high-gain anode foil and a low-resistivity electrolyte system. The anode foil is created through a proprietary electrochemical etching process that gives the aluminum foil a high etching factor. The capacitor comes in a printed-circuit-board configuration or with standard screw terminals.

The typical price for a 16,000-μf, 50-V unit is under $3.25 in lots of 1,000. Delivery is within six weeks.

Mepco/Electra Inc., Columbia Rd., Morristown, N.J. 07960.
Phone (201) 539-2000 [Circle 383]

DATA CONVERTERS

Monolithic DAC80 version puts out current

A monolithic current-output version of the industry standard DAC80 digital-to-analog converter specifies ±2% maximum gain error in addition to a linearity error of ±½ least-significant-bit maximum. The AD DAC80I 12-bit converter has a maximum dissipation of 450 mW.

The tightly specified output current simplifies unit-to-unit trimming requirements and facilitates use in applications that require very fast settling time or use a d-a converter as a building block with external gain-setting resistors.

The DAC80I operates with ±12- or 15-V power supplies. Features include 300-ns settling to ±0.01% of full scale, guaranteed monotonicity over a 0° to +70°C temperature range, and a compliance-voltage range of –2.5 V to +10 V.

Available in 24-pin hermetically sealed ceramic dual in-line packages, the AD DAC80I provides complementary binary input coding. It is shipped from stock and sells for $15.50 each when purchased in large quantities.

Analog Devices Inc., Rte. 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062.
Phone (617) 935-5565 [Circle 373]

16-bit a-d converter gives six input ranges

The model 3120 analog-to-digital converter features 16-bit resolution, and is linear within ±0.003% over its operating range. Input range is customer programmable to ±10 V, ±5 V, ±2.5 V, 0 to 10 V, 0 to 5 V, and 0 to 20 V. The maximum conversion time at 14 bits of resolution is just 15 μs.

The model 3120 includes internal reference and offers a short-cycling provision. Data is available in serial or parallel form, with corresponding clock and status output. Digital inputs and outputs are diode-transistor-logic and TTL compatible.

In the standard 1.09-in.-by-1.7-in. package, the model 3120 is priced at $188 each in 100-quantity orders. Delivery takes about four weeks after receipt of order.

Dynamic Measurements Corp., 8 Lowell Ave., Winchester, Mass. 01890.
Phone (800) 225-1151 [Circle 374]

PC BOARDS

Dense board makes redesigns inexpensive

Unilayer II, a high-density interconnection packaging technique, eliminates much of the expense often associated with production redesigns of wiring. Because the technique uses computer-stored design information and premanufactured board modules, new designs can be started in wire-wrap for prototyping and converted directly into Unilayer II wiring to meet production requirements.

Universal board modules are supplied with individual wire-wrap sockets for wire-wrap prototyping and converted to Holtite Zero-Profile sockets and Unilayer II wiring layers with soldered connections. The technique maintains circuit densities equal to multilayer designs, allows components to plug into the board, and keeps wire changes easy to make from prototyping to production.

In lots of 25, the typical price of a wired, tested, and socketed board is about $3 per integrated-circuit position. Special designs take about eight weeks to produce and ship.

Augat Inc., Interconnection Systems Division, 40 Perry Ave., P.O. Box 1037, Attleboro, Mass. 02703.
Phone (617) 222-2202 [Circle 392]

TAPE DRIVES

Inclusion of SCSI adds intelligence to drive series

The model 540S, a ¼-in. streaming cartridge tape drive with the Small Computer System Interface, is now available for the company's 540 series of 5.25-in. form-factor tape drives. With this addition, the company offers system integrators a choice of three interfaces for the 540 series—the model 540 with a QIC-02-compatible interface, the model 540B with a QIC-36 interface, and the model 540S with SCSI.

Each of the 540 drives, which offer up to 60 megabytes of data storage, can format data to specifications using standard ¼-in. tape cartridges. Because of its intelligence, the 540S frees the host computer for other tasks by supporting an off-line drive-to-tape or tape-to-drive copy. The 540S also relieves bus congestion by queuing comands that are received simultaneously.

Pricing was unavailable at press time; the model 540S will be available in August.

Cipher Data Products Inc., 9815 Carroll Canyon Rd., P.O. Box 85170, San Diego, Calif. 92138.
Phone (619) 578-9100 [Circle 382]

PRINTERS

Laser printer can produce 20 pages/min

The LBP-20 laser beam unit prints 20 pages/min on both sides of a cut sheet of paper at a resolution of up to 480 by 480 dots/in. With the appropriate interface, the software-controlled printer is suited to a variety of high-duty-cycle applications. It is available in a number of configurations, making it flexible within such applications as distributed data processing and shared-resource office automation.

The base engine of the LBP-20 can print with a factory preset resolution of 240, 300, 400, or 480 dots/in. on letter, legal, or ledger-sized paper.

Production units of the printer, which has a long-life amorphous-silicon photosensitive drum, will be available during the first half of 1985. Pricing has not yet been determined.

Canon USA Inc., Copier Division, 1 Canon Plaza, Lake Success, N.Y.
Phone (516) 488-6700 [Circle 393]

Battery-powered portable prints 60 characters/s

A portable 80-column printer priced at $199.95 can be used with most home and personal computers, including battery-powered portables. Called the Traveler, the 5½-lb unit uses thermal printing technology to print at a rate of 60 characters/s.

The printer will print 100 pages of text and graphics before its batteries must be recharged by a built-in unit; it can also be powered from a standard ac electrical outlet. The printer combines a single-chip microprocessor with a dot-matrix mechanism that prints 8 by 10 characters with true descenders and offers 640 dots/line bit-mapped graphics.

A thermal paper roll, rechargeable batteries, and a 100-V ac adapter/recharger are included in the retail price of the printer, which will be available starting in October. Interface cables for computers with serial RS-232-C or RS-422 ports are priced at $49.95.

Alphacom Inc., 2323 South Bascom Ave., Campbell, Calif. 95008.
Phone (408) 559-8000 [Circle 398]

MINICOMPUTERS

Midrange minicomputer supports 128 users, does 255 tasks at once

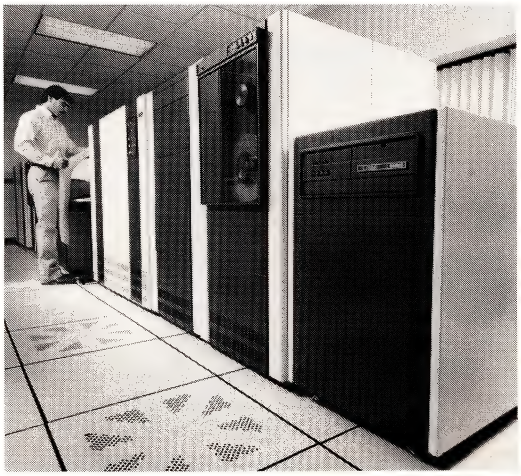
One of two midrange superminicomputers, the Prime 9750 incorporates emitter-coupled-logic circuitry along with a five-stage pipelined central processing unit architecture, providing a performance 75% better than that of the Prime 750. In addition, it supports up to 128 terminals and 255 interactive processes simultaneously.

Its companion, the Prime 9650, uses a custom gate-array-based processor and two-stage pipelined architecture. This superminicomputer offers an overall system performance 35% greater than that of the Prime 550-II and supports up to 96 terminals and 255 interactive processes simultaneously.

Suitable for a range of computational, commercial, and computer-aided design applications, both systems include two 315-megabyte fixed-media disks, a 1,600-b/in. streaming magnetic tape subsystem, a cathode ray tube console, and the Primos operating system. The Prime 9750 includes 4 megabytes of memory; the 9650 comes with 2 megabytes.

Available in August, the Prime 9750 will sell for $251,500 for a typical configuration. The Prime 9650 will sell for $146,500. Already installed systems can be upgraded to the Prime 9750 level at a cost starting at $98,000 or to the 9650 level at a cost starting at $52,000.

Prime Computer Inc., Prime Park, Natick, Mass. 01760.
Phone (617) 665-8000 [Circle 376]



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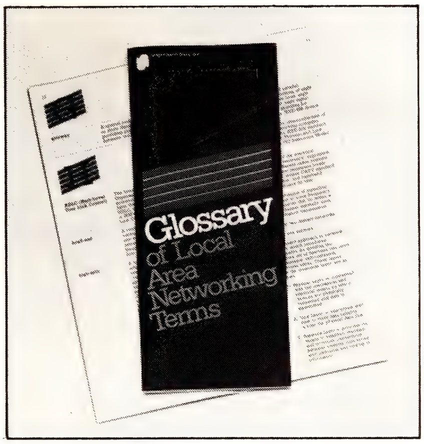

Networks defined. A 24-page booklet defines more than 100 terms commonly used in the local-network industry. Meant to help amateurs better understand these systems, the *Glossary of Local Area Networking Terms* explains the differences among media, access methods, and topologies and defines such basic terms as gateway, datagram, virtual circuit, and packet switching. For a free copy, write on corporate stationary to Ungermann-Bass Inc., 2560 Mission College Blvd., Santa Clara, Calif. 95050. [Circle reader service number 421]

Device noise. *Analog Dialogue*'s latest edition (Vol. 18, No. 1) features a tutorial review of device noise and discusses white, flicker, and popcorn noise. Other application articles describe the use of digital multipliers in math function approximations and a thermocouple preamplifier installed in a rate-of-cooling meter. For a complimentary copy, call (617) 329-4700 or write to Analog Devices Inc., Rte. 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062. [Circle 423]

Europe's best. Benn's *European Electronic Components Distributor Directory 1984* is a buyer's reference to the products of some 7,000 worldwide electronic components manufacturers. It includes more than 36 types of components from companies in 14 countries and has a manufacturers' cross-reference index that lists their distribution outlets in each country, a useful source for buyers who are looking for a particular brand-name component or for industry analysts tracking the distribution strategy of individual manufacturers. The directory sells for $99 (£40 in the UK). For more information, get in touch with Benn Electronics Publications, P.O. Box 28, Luton, Bedfordshire LU2 0ED, England. [Circle 425]

Thick and thin. The *Thick and Thin Film Resistor Networks* catalog provides the engineering information needed to choose a resistor network for almost any application. This 15-page bulletin features electrical, physical, and environmental specifications and, where appropriate, military-specification performance data for TRW's entire line of thick- and thin-film resistor networks. For a copy of Bulletin 803A, call (215) 922-8900 or write to TRW Electronic Components Group, Resistive Products Division, 401 N. Broad St., Philadelphia, Pa. 19108. [Circle 426]

Counting the ways. *Motorgram*'s current issue (Vol. 63, No. 6) reviews the International System of Units. One article claims that the system resembles the metric one but is more comprehensive and has more precise base units, features that are important in scientific calculations. The first part of this series describes and tells the history of base units of length, mass, and time. Other important base units are given, too. For a copy of *Motorgram*, write to Bodine Electric Co., 2500 W. Bradley Pl., Chicago, Ill. 60618. [Circle 427]

VLSI equipment. A six-page brochure describes three optical step-and-repeat systems for very large-scale integration. The publication covers all aspects of the reduction-projection mechanism in detail, lists its specifications, and includes a photograph of the resolution it achieves. Three Nikon Precision Inc. systems are described: the NSR-1010G, the NSR-1505G, and the NSR-2005G. For a copy of the brochure, call (415) 952-8188 or write to the company at 1051 Sneath Lane, San Bruno, Calif. 94066. [Circle 430]

Conductive coatings. Cost-cutting information on radio-frequency and electromagnetic interference conductive coatings is contained in a four-page brochure that describes surface preparation, mixing and handling, spray equipment, masking of parts, applications of RFI/EMI coatings, and quality-control methods. Other topics include testing, safety precautions, and the drying schedule of conductive coatings. For more information, get in touch with Advanced Coatings & Chemicals Corp., 4343 Temple City Blvd., Temple City, Calif. 91780. [Circle 429]

What's the buzz. Rosenthal Technik's free six-page brochure describes the company's complete line of piezoelectric buzzer elements. The literature features specification charts and technical diagrams that illustrate styles, dimensions, and characteristics of standard types, mounting modes, resonator frequency formula, and driving circuits. Designed as a reference for specification and design engineers, the brochure also contains several charts depicting buzzer sound-pressure level versus frequency, buzzer power consumption, sound pressure level and current versus voltage, and buzzer capacitance, frequency, and resistance to temperature. For a copy of the brochure, call (401) 943-2200 or write to Rosenthal Technik North America Inc., 100 Niantic Ave., Providence, R.I. 02907. [Circle 422]

Meetings

Userfest/New York, Northeast Expositions (822 Boylston St., Chestnut Hill, Mass. 02167), Madison Square Garden, New York, Sept. 20-23.

10th International Broadcasting Convention, Institute of Electrical Engineers, *et al.* (IBC Secretariat, IEE, Savoy Place, London, UK, WC2R OBL), Metropole Conference and Exhibition Centre, Brighton, UK, Sept. 21-25.

Intelligent Buildings/Information Systems Conference, Cross Information Co. (934 Pearl St., Suite B, Boulder, Colo. 80302-5181), Hilton Hotel, Boulder, Sept. 22-24.

PCExpo, IBM Corp. (PCExpo, 333 Sylvan Ave., Englewood Cliffs, N.J. 07632), Anaheim Convention Center, Anaheim, Calif., Sept. 24-26.

National Communications Forum, National Engineering Consortium (Robert M. Janowiak, National Communications Forum, 505 N. Lake Shore Dr., Suite 4808, Chicago, Ill. 60611), O'Hare Inn, Des Plaines, Ill., Sept. 24-26.

Swissdata 84, Exhibition for Data Processing in Industry, Technical Application and Research, Swiss Industries Fair (Swissdata 84, c/o Swiss Industries Fair, CH-4021 Basel, Switzerland), Swiss Industries Fair, Sept. 25-29.

Eurocon 84, 6th Conference on Electrotechnics, Institute of Electrical Engineers *et al.* (The Manager, Conference Services, IEE, Savoy Place, London WC2R OBL, UK), Brighton, UK, Sept. 26-28.

14th International Symposium and Exhibition on Industrial Robots, Society of Manufacturing Engineers (Patricia Van Doren, RE/SME, 1 SME Dr., P.O. Box 950, Dearborn, Mich. 48121), Gothenburg, Sweden, Oct. 1-4.

iAPX 86, 88, 186 Microprocessors Workshop, Intel Corp. (27 Industrial Ave., Chelmsford, Mass. 10824), Intel Training Center, Chelmsford, Oct. 1-5.

Copimera 84, Mechanical and Electrical Engineer's Association of Buenos Aires (David R. Reyes-Guerra, ABET, 345 E. 47th St., New York, N.Y. 10017), Centro Cultural San Martin, Buenos Aires, Oct. 1-5.

6th International Symposium on Subscriber Loops and Services, Société des Electriciens, des Electroniciens, et des Radioélectriciens and IEEE (Solange Le Brun, SEE, 48, rue de la Procession, 75724 Paris, France CEDEX 15), Nice, France, Oct. 1-5.

Symposium on Optical Fiber Measurements, National Bureau of Standards, IEEE, and Optical Society of America (Collier Smith, U.S. Department of Commerce, NBS, Washington, D.C. 20234), NBS, Boulder, Colo., Oct. 2-3.

Gidep Workshop, Government-Industry Data Exchange Program (Gidep Operations Center, Corona, Calif. 91720), Sheraton Hotel, Spokane, Wash., Oct. 2-4.

Pecora IX Remote Sensing Symposium, IEEE *et al.* (William L. Alford, Code 933, NASA/GSFC, Greenbelt, Md. 20771), Howard Johnson Convention Center, Sioux Falls, S.D., Oct. 2-4.

Automatic Testing and Test Instrumentation 84, Network Events Ltd. (Printers Mews, Market Hill, Buckingham, MK181JK, UK), Palais des Congres, Paris, Oct. 2-4.

Seminars

Fault and Disturbance, Sangamo (Steve Jack, Sangamo T & D Department, P.O. Box 48400, Atlanta, Ga. 30362), Ramada Renaissance Hotel, Atlanta, Sept. 25-26.

Non-Monotonic Reasoning, American Association for Artificial Intelligence (Ray Reiter, Department of Computer Science, University of British Columbia, Vancouver, B.C. V6T 1W5, Canada), Mohonk Mountain House, New Paltz, N.Y., Oct. 17-19.

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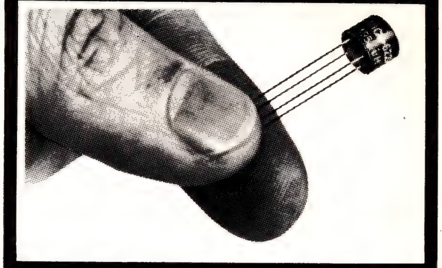

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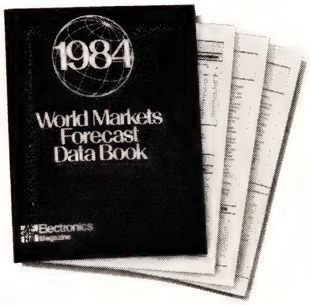

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- knowledge of electromagnetic wave theory, microwave measurement technology, and RF system design and analysis (ID# 5708/5710/5720)
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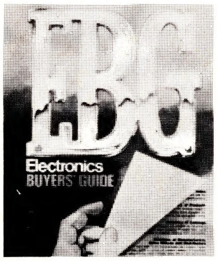

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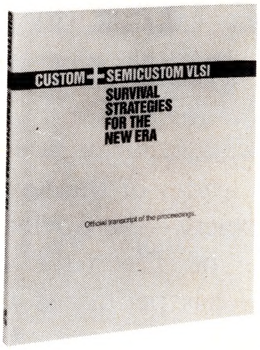
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THE IEEE WOULD DO WELL TO REJECT SOVIET DEALS

The leader of the Soviet Union's A.S. Popov Society—the Soviet's equivalent of the Institute of Electrical and Electronics Engineers—has petitioned the IEEE to reestablish a technical exchange program between the two organizations. The Popov leader wants a return to the relationship with the IEEE that existed before 1980, when the institute exhibited an uncharacteristic boldness and told the Soviets that it was fed up with one-sided exchanges and canceled the deal.

It seems that the IEEE has invited the Popov request by concluding late last year that it was time to reevaluate the freeze. The IEEE decision was correct. However, we hope that the spirit of fairness the institute's leadership demonstrated in raising the issue once again does not seduce it into taking a heedless step to willy-nilly reestablish the technical-information exchange between the two groups.

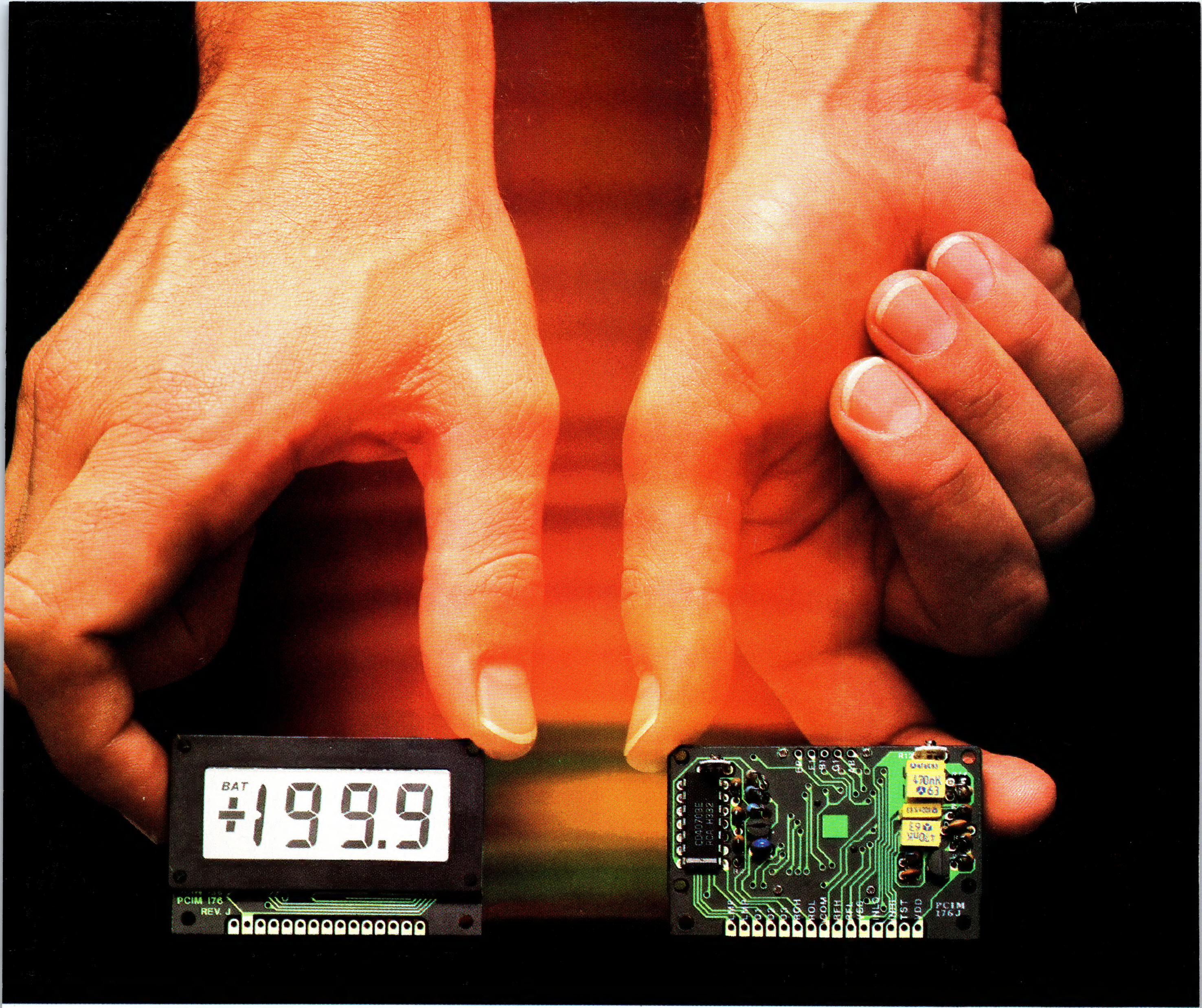
The IEEE's original ban was imposed in 1980, following the Soviet Union's invasion of Afghanistan, when the tension between the Soviets and Western nations was at a boiling point. We suspect that in the frenzy of worldwide anti-Soviet feeling, the IEEE found the right moment to rid itself of a deal that it felt had gone sour. There was, and still is, nearly universal agreement among technology watchers that the Soviets treated the agreement—as they do all such exchanges—as a mission dedicated to extracting crucial information from the Western world under the guise of an exchange. What Moscow proffers, instead, is obsolete, misleading, or even incorrect information in exchange.

What has the Soviet Union done since 1980 to demonstrate that it could participate as an even-handed partner in such an exchange? Nothing. It has, in fact, shown quite the opposite. With its reckless downing of the Korean Air Lines flight 007 last year, the Soviets have clearly demonstrated their disregard for long-established rules of international civility as well as the low value they place on human life.

With their usually bumbling attempts to infiltrate high-technology centers in the United States, Western Europe, and Japan to steal technical achievements far in advance of any they could produce in their state-controlled universities and industries, the Soviets have shown the world, and the technical community in particular, what they think about fair exchange.

The Soviet Union has a great deal to gain and absolutely nothing to lose if the IEEE were to once again share technical information with the A.S. Popov Society. Today's Soviet policy, as developed under the leadership of its newest premier, Konstantin Chernenko, seems to be based on a harder line toward the West. In the age of high technology, it is certain that he and his fellows in Moscow are needled by the technical gap between the Soviet Union and the rest of the world. It is also quite certain that the hard liners now in command will do everything possible to narrow that gap. That policy could well include sending the Popov leadership to the U.S. with hat in hand, a pocketful of promises to play fair, and possibly even news of a Soviet high-technology development or two to woo the IEEE leaders.

Beware Russians bearing gifts. The IEEE must reject any attempt by the Popov Society to bring back the good old days because there never were any good old days. And despite some recent fencing between Moscow and Washington over possible arms talks, from the look of things, the days, months, and years ahead are going to be more difficult than they ever have been for establishing meaningful relationships between the West and Moscow.



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